# ABSTRACTS OF NORTH AMERICAN GEOLOGY

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# ABSTRACTS OF NORTH AMERICAN GEOLOGY

## INTRODUCTION

Abstracts of North American Geology contains abstracts of technical papers and books and also citations of maps on the geology of North America including Greenland, the West Indies, as well as the State of Hawaii, Guam, and other island possessions of the United States. Articles of a general nature by North American authors are cited even though published in foreign journals, but those by foreign authors are included only if they appear in North American journals. Abstracts are prepared only of material that is believed to be generally available. Ordinarily abstracts are not published of material with limited circulations (such as dissertations, open-file reports, or memorandums) or of other papers presented orally at meetings.

The Abstracts will be an additional reference tool but will not replace the Bibliography of North American Geology, which has been published by the Geological Survey since 1887. Twelve monthly issues of Abstracts of North American Geology will be published each year. The Bibliography will include citations and subject index for a calendar year.

Abstracts of North American Geology and the Bibliography are being prepared by use of computer techniques. Each abstract along with its indexing is placed on magnetic tape and entered into a permanent data bank. The material prepared each month will be published in the form of the present issue. The abstracts are arranged alphabetically according to senior author. A subject index follows the abstracts and is designed for rapid reference to any subject desired. Bibliographies can subsequently be retrieved according to the terms used in the index.

The abstracts in this issue were prepared by Joan R. Clark, J. W. Clarke, Georgianna D. Conant, Margaret Cooper, W. C. Culbertson, A. A. Drake, Wanda L. Grimes, B. C. Hearn, R. M. Hernon, Virginia M. Jussen, B. H. Kent, A. R. Kinkel, Marie L. Lindberg, Elisabeth S. Loud, E. K. Maughan, Mildred C. Mead, Virginia S. Neuschel, E. H. Roseboom, S. P. Schweinfurth, G. I. Smith, Dorothy B. Vitaliano, W. S. White, and E-an Zen.

1023 **Abou-Seida, Mohamed Mokhles.** Bed load function due to wave action [abs.]: Dissert. Abs., v. 26, no. 2, p. 940, 1965.

0992 **Agenbroad, Larry.** Interpretation and correlation of geophysical well logs with geology for instrument holes . . ., *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 165–183, illus., 1964 [1965].

This study was made to interpret geophysical well logs run in instrumentation holes and to correlate the information with data obtained from geologic analysis of rotary drill cuttings and short drill core intervals. Logs used in study included caliper, temperature, sonic, radiation, formation density, electric, microlaterlog, Frac-Finder, and Micro-Seismogram. All the holes including the PM (particle motion) set were in granite near the Project Shoal site. With the exception of two holes, the majority of "open" or "log-detected" fractures occur at depths of less than 800 feet. Sulfide mineralization (pyrite) occurred at various depths from 320 to 920 feet. Average granite density was 2.77 g/cc and average velocity for unfractured granite, 18,000 ft/sec.—M.C.

1122 **Albright, James L.** Lisbon Valley anticline, Paradox basin, Utah—Exploration and development [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1571, 1965.

1232 **Allen, C. R.; Saint Amand, Pierre; Richter, C. F.; Nordquist, J. M.** Relationship between seismicity and geologic structure in the southern California region: Seismol. Soc. America Bull., v. 55, no. 4, p. 753–797, illus., tables, 1965.

Data from 10,126 southern California earthquakes in 1934–63 have been synthesized in an attempt to understand better their relationship to regional geologic structure. Most earthquakes with magnitudes $\geq 6$ were on major faults. Smaller shocks are much more randomly distributed, and most are not clearly associated with any mappable surficial faults. Not all intensely faulted areas have been active during the period in question, but this quiescence may be temporary. Recurrence curves of magnitude vs. frequency, presented for six areas of 8,500 sq km, show that either the area is too small or the time too short for estimating valid expectancies. A recurrence rate of 52 yr for $M = 8.0$ earthquakes for the entire region may well be valid.—D.B.V.

1105 **Alliger, Jerald; Thomas, Gilbert.** Comprehensive surface mapping in Williston basin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1577, 1965.

1393 **Almy, Charles Coit, Jr.** Parguera Limestone, Upper Cretaceous Mayaguez Group, southwest Puerto Rico [abs.]: Houston Geol. Soc. Bull., v. 8, no. 3, p. 16–17, 1965.

1072 **Alonso Espinosa, Héctor; Anda, L. F. de; Mooser, Federico.** Focos termales en la República Mexicana [with English abstract]: Asoc. Mexicana Geólogos Petroleros Bol., v. 16, nos. 7–8, p. 145–151, illus., table, 1964.

Thermal springs of Mexico are listed, with locality, type of spring, and temperature of water. Most of the springs are related to Quaternary volcanism with intense fracturing, suggesting the presence of intrusive bodies or magmatic chambers at shallow depth.—V.M.J.

1169 **Amelinckx, S.** The direct observation of dislocations, Supp. 6 *of* Solid state physics—Advances in research and applications: New York, Academic Press, 487 p., illus., tables, 1964.

Various aspects of crystallographic techniques are discussed in detail in this volume, especially methods of crystal structure analysis with consideration of the phase problem and use of anomalous dispersion, crystal perfection and disorder, and applications of electron and neutron diffraction techniques. Information on instrumentation is included. The theory underlying calculations of the vibrational properties of imperfect crystals is presented, covering isolated point defects, disorder, and crystal surfaces. By way of introduction, the author provides a summary of the formal elements of the theory of lattice dynamics for perfect crystals, results of recent work on the frequency spectra of solids, and a historical survey of the subject.—G.D.C.

**Ammer, B.** *See* Plant, C. E. 1360

**Anda, L. F. de.** *See* Alonso Espinosa, Héctor, 1072

1255 **Anders, Edward.** Diamonds in meteorites: Sci. American, v. 213, no. 4, p. 26–36, illus., 1965.

Four well-documented occurrences of diamond-bearing meteorites are known; three of these are stony meteorites from Asia and the fourth is the iron meteorite from Meteor Crater in Arizona. Diamonds in these meteorites are poorly developed and probably represent carbon that recrystallized by shock greater than 600 kilobars. The diamonds from Meteor Crater probably formed on Earth impact whereas those in the stony meteorites probably formed by impact in space. Radiometric dates and a study of iron isotopes and nickel-iron intergrowths suggest that the parent body of the Meteor Crater body was in existence 455 b.y. ago, suffered an initial collision in space 540 m.y. ago and subsequent collisions at 170 and 15 m.y. Many of the iron meteorites found on Earth were probably produced by a major space cataclysm which occurred about 500–600 m.y. ago.—A.A.D.

1149 **Anderson, K. H.** Forest City basin of Missouri, Kansas, Nebraska, and Iowa [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1564, 1965.

1205 **Anderson, Orson L.; Schreiber, Edward.** The pressure derivatives of the sound velocities of polycrystalline magnesia: Jour. Geophys. Research, v. 70, no. 20, p. 5241–5248, illus., tables, 1965.

As MgO probably exists as a separate phase in the Earth's mantle, the effect of pressure on sound velocities of MgO is important to current theories of the Earth's interior. The sound velocities and pressure derivatives of the sound velocities of a gem-quality sample of polycrystalline MgO were measured by the "phase comparison" technique. The results yield a vanishingly small value of the pressure derivative of Poisson's ratio. The acoustic Grüneisen constant is estimated to be 1.60, in very good agreement with that obtained from thermal properties.—D.B.V.

**Andrews, Henry N.** *See* Phillips, Tom L. 1246

1080 **Andrews, J. T.** The corries of the northern Nain–Okak section of Labrador [with French abstract]: Canada Dept. Mines and Tech. Surveys Geog. Br. Geog. Bull., v. 7, no. 2, p. 129–136, illus., 1965.

The pattern of corrie glaciers in the area is explained as being dependent on two variables, the inclination of the last Saglek glacial limit and the incidence of areas with sufficient relief. On the coast the corrie orientation is varied and the height of the corrie floor/backwall junction is about 300 m. The altitude of the junction increases to the west and orientation becomes progressively restricted to the

northeast. Study of the present climate suggests an anomalous relationship between the major precipitation-bearing air flows and corrie orientation.—M.C.

1404 **Appleman, Daniel E.; Evans, Howard T., Jr.** The crystal structures of synthetic anhydrous carnotite, $K_2(UO_2)_2V_2O_8$, and its cesium analogue, $Cs_2(UO_2)_2V_2O_8$: Am. Mineralogist, v. 50, nos. 7–8, p. 825–842, illus., tables, 1965.

The crystal structures of synthetic anhydrous carnotite and its cesium analogue have been determined. The structures contain tightly bonded sheets made up of uranium and vanadium coordination polyhedra sharing edges. The sheets are held together by bonds from oxygen atoms to the interlayer $K^+$ or $Cs^+$ cations. In the cesium compound the linear, symmetrical uranyl ion is coordinated by five oxygen atoms in the form of a plane pentagon. The vanadium atom is coordinated by five oxygen atoms in the form of a square pyramid. Two such pyramids share an edge of the base, their apices pointing in opposite directions, to form divanadate groups, $V_2O_8$. The interlayer bonding consists of eleven Cs–O bonds, five to one layer and six to the adjacent layer.—from authors' abstract

1194 **Arnold, A. B.** Results of the foundation investigation and rock testing for the Delta Pumping Plant, Tracy, California: Eng. Geology, v. 2, no. 1, p. 7–14, illus., 1965.

The California aqueduct will begin at the Delta Pumping Plant, located about 11 miles northwest of Tracy, Calif. The plant will lift the water from the San Joaquin River 243 feet up into the aqueduct. Seismic refraction measurements were made on the surface and down drill holes to determine the elastic modulus of foundation materials and to survey the area for faults and deeply weathered zones. Results were helpful in determining the homogeneity of the foundation selected for the pumping plant structures, which are in the Cretaceous Panoche Formation. To evaluate the elastic and plastic movements of the foundation, nine rebound gages were installed at critical locations before excavation for the pumping plant began.—M.C.

1100 **Asquith, Donald O.** Mesaverde and "Almy" production, Birch Creek unit, Sublette County, Wyoming [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1576–1577, 1965.

1101 **Baars, D. L.** Pre-Pennsylvanian paleotectonics—Key to basin evolution and petroleum occurrences in Paradox basin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1572, 1965.

**Baer, A. J.** *See* Hutchison, W. W. 1211

**Bailey, H. H.** *See* Hutcheson, T. B., Jr. 1004

**Bailey, S. W.** *See* Doman, R. C. 1184

1028 **Baker, Robert Jethro, Jr.** Phase equilibria studies in the system $MgO$–$Al_2O_3$–$ZrO_2$ [abs.]: Dissert. Abs., v. 26, no. 2, p. 929, 1965.

**Baker, W. H.** *See* Prickett, T. A. 1383

1118 **Ballard, William W.** Kibbey Formation of Montana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1571, 1965.

**Ballman, A. A.** *See* Laudise, R. A. 1061

**Banks, D. C.** *See* Nugent, R. C. 1241

1414 **Bannerman, Harold M.** The role of the Society of Economic Geologists: Econ. Geology, v. 60, no. 7, p. 1347–1365, illus., 1965.

The Society was founded in 1920 for the dual purpose of advancing the science of geology and applying geologic principles, knowledge, and techniques to useful ends. Analysis of program content shows that its programs have become increasingly

concerned with geology, geochemistry, and geophysics as applied to the study of mineral deposits, and that other fields of economic geology, such as petroleum geology, engineering geology, and ground-water geology, have developed independent organizations. Growing impact of modern experimental research increases the importance of the Society's role as a link between field and laboratory.—W.S.W.

1109 **Barlow, James A.; Haun, John D.** Stratigraphic accumulation of oil in Salt Creek field, Natrona County, Wyoming [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1574, 1965.

**Barnes, Robert H.** *See* Larson, Lawrence T. 1377

**Barnes, Robert H.** *See* Moore, Gerald K. 1399

1263 **Barnes, Virgil E.** Geologic map of the Rocky Creek quadrangle, Blanco and Gillespie Counties, Texas: Texas Univ. Bur. Econ. Geology Geol. Quad. Map 29, scale 1:24,000, separate text, 1965.

Rocky Creek quadrangle is high on the southeastern side of the Llano uplift. Precambrian, Cambrian, and Ordovician rocks crop out in about 60 percent of the quadrangle; Cretaceous rocks and Quaternary surficial deposits occupy the remainder. Paleozoic and Precambrian rocks in outcrop are extensively faulted, and beneath the Cretaceous their structural pattern should be about the same. The quadrangle is mostly in an area of minimum gravity associated with the Grape Creek Granite mass. Mineral resources are limited to nonmetallic construction materials and water except for a minor occurrence of lead and zinc around the exhumed granite hills along Pedernales River and Iron Rock Creek. A stratigraphic section and bibliography are included.—M.C.M.

1046 **Barnhisel, Richard Irven.** The formation and stability of aluminum interlayers in clays [abs.]: Dissert. Abs., v. 26, no. 2, p. 1078, 1965.

**Barraclough, Jack T.** *See* Musgrove, Rufus H. 1077

1438 **Barry, G. S.** Geology of the Trophy Lake area (east half) 64C/2 (east): Manitoba Dept. Mines and Nat. Resources Pub. 63-3, 47 p., illus., tables, geol. map, 1965.

The area lies south of Granville Lake and its rocks are limited to Precambrian Wasekwan meta-sediments and meta-volcanics; Pre-Sickle(?) gabbro, amphibolite, and diorite; Sickle meta-volcanics and meta-sediments; Wasekwan granulites, schists, and gneisses; and intrusive granite, pegmatite, granodiorite, and gabbro, all separated from Pleistocene and Recent deposits by a great unconformity. Chemical and modal analyses were made on greywacke, subgreywacke, gabbro, "calc-silicate" rocks, granite, and granodiorite. Grab samples from 35 locations were assayed for gold, silver, copper, nickel, zinc, and lead. One sample contained all the metals but nickel, and sixteen others had a gold content of a trace to 0.15 per ton. The other 34 samples had no other metals.—M.C.

1020 **Barry, Thomas Leo.** Kinetics, phase equilibria, and crystal chemical studies in rare earth oxide-alkaline earth oxide systems [abs.]: Dissert. Abs., v. 26, no. 2, p. 717, 1965.

1096 **Bartlett, C. S., Jr.** New approaches to Arkoma basin gas exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1562, 1965.

**Basham, P. W.** *See* Ichikawa, M. 1376

**Bates, Charles C.** *See* Jordan, James. 1231

1008 **Beal, Laurence H.; Jerome, S. E.; Lutsey, Ira; Olson, Richard H.; Schilling, John H.** Geology of the Sand Springs Range, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 24-35, geol. map, 1964 [1965].

Sand Springs Range is a north–south trending fault block of Cretaceous granitic rock, almost batholithic in size, flanked on the north and south by Mesozoic metamorphic rocks and Tertiary–Quaternary volcanics. Tertiary–Quaternary unconsolidated sediments form the east and west borders in Fourmile Flat and Fairview Valley. The granitic core is cut by many aplite–pegmatite, andesite, and rhyolite dikes. Folding is prominent only at the south end but several sets of joints and faults are present. Contact metasomatic tungsten deposits occur in the metamorphic sequence, mostly in limestone along the contact with the granitic body, but cannot be worked profitably. East–west veins in a northern shear zone have produced gold and silver. Salt is harvested from a playa on Fourmile Flat.—M.C.

**Beck, A. E.** *See* Beck, J. M. 1204

0998 **Beck, Alan E.** Techniques of measuring heat flow on land, Chap. 3 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 24–57, illus., table, 1965.

Methods used in determining a value for terrestrial heat flow over land are discussed. Some examples of apparatus and techniques for determining the thermal conductivity of rocks and the temperature gradient in the crust are described: the apparatus described can be built up using fairly simple pieces of equipment, and elaborate techniques are not normally required. Problems and possible sources of error associated with the various techniques are also discussed.—Author's abstract

1204 **Beck, J. M.; Beck, A. E.** Computing thermal conductivities of rocks from chips and conventional specimens: Jour. Geophys. Research, v. 70, no. 20, p. 5227–5239, illus., tables, 1965.

Suggestions are made for detecting minerals arranged in parallel in rock specimens of the size commonly used for thermal conductivity measurements. Methods are proposed for testing the validity of conductivities computed from the composition of a specimen for various simple models. Application of the tests to a set of 48 disks of a coarse-grained granite showed that the parallel model could definitely be discarded, but that it was difficult to distinguish between the dispersive and series models. Feldspar conductivity was significantly higher and biotite lower than previously supposed. The application to computing the conductivity of rocks from chips is discussed.—D.B.V.

1437 **Behrens, E. William.** Environment reconstruction for a part of the Glen Rose Limestone, central Texas: Sedimentology, v. 4, nos. 1–2, p. 65–111, illus., tables, 1965.

A 50-ft section of this Lower Cretaceous formation was sampled at 24 localities, and 199 of about 550 samples were subjected to point-count, X-ray, and insoluble residue analyses. Statistical analyses of data by computer yielded the following facies: under the upper evaporite and barren mudstone layer, a *Corbula* facies with ostracods and foraminifers, a steinkern facies with mollusks and the foraminifer *Orbitolina*, a mudstone facies, and a mixed particle facies. Facies distribution for all the samples was determined. In order of age and position, the facies were deposited as follows: lowest mixed particle beds in very shallow, intertidal waters; mudstone and steinkern facies under normal marine conditions; *Corbula* facies under hypersaline conditions during restricted circulation; and evaporites and barren mudstones under increased hypersalinity.—M.C.

**Bennett, Theron J.** *See* Bradley, Edward A. 1346

**Berry, Frederick A. F.** *See* Carlson, Charles G. 1283

1304 **Berry, L. G.; Rao, S. V. L. N.** A method for taking back reflection oscillation photographs of single crystals: Am. Mineralogist, v. 50, nos. 7–8, p. 1118–1121, illus., 1965.

Standard Weissenberg and oscillation cameras that are currently limited to a maximum oscillation angle of about 30° can be modified by attachment of a brass

block to the lead screw so that a maximum oscillation angle of 140° can be obtained.—J.R.C.

1364 **Bigeleisen, Jacob.** Chemistry of isotopes: Science, v. 147, no. 3657, p. 463–471, illus., tables, 1965.

This survey of the principles of isotope chemistry and their practical use includes a section on geochemical applications, in which results of studies on sulfur isotope variations in nature by Thode and others (1951) and paleotemperature studies based on oxygen isotopes are discussed briefly.—D.B.V.

**Biggs, W. P.** *See* Tixier, M. P. 1193

1160 **Birch, F. S.** Heat flow near the New England seamounts: Jour. Geophys. Research, v. 70, no. 20, p. 5223–5226, illus., table, 1965.

Five heat flow measurements were made near the bases of Retriever, Picket, and Balanus seamounts in the New England seamount chain as part of a general survey of the seamounts and to determine whether there is any remanent volcanism associated with them. The heat flow of four stations has a mean of 1.09 μcal/cm² sec; these stations are all the same within the accuracy of measurement. The heat flow at the fifth station is 1.34 to 1.65 μcal/cm² sec. There are several possible explanations for this higher heat flow; none of these can be selected as the correct explanation. There is no evidence of remanent volcanic heat around the seamounts.—Author's abstract

**Birle, J. D.** *See* Schopf, J. M. 1198

1250 **Black, Douglas F. B.** Cryptoexplosive structure near Versailles, Kentucky, *in* Geol. Soc. Kentucky, Field Trip 1965: Lexington, Kentucky Geol. Survey, p. 44–51, illus., condensed and revised 1965; originally published 1964.

This circular structure nearly a mile in diameter was discovered in 1962 and consists of a brecciated central dome, a marginal structural depression partly bounded by normal faults, and, on the east, by an outer semicircular anticline of low amplitude. The central uplift is an asymmetrical dome in which the Lexington Limestone may be crosscut by faults or underlain by a lense of limestone breccia. The structure is of Late Ordovician or younger age. Its similarity to structures of known and supposed meteorite impact origin and the high degree of brecciation, otherwise rare in the region, may indicate a similar origin for it. The possibility of a volcanic origin postulated by Bucher in 1933 and 1936 for some structures of this type cannot be abandoned although no evidence of volcanism has been found.—M.C.

1307 **Black, Douglas F. B.; MacQuown, W. C., Jr.** Lithostratigraphy of the Ordovician Lexington Limestone and Clays Ferry Formation of the central Bluegrass area near Lexington, Kentucky, *in* Geol. Soc. Kentucky, Field Trip 1965: Lexington, Kentucky Geol. Survey, p. 6–43, 50–51, illus., 1965.

The complicated lithofacies of the Lexington Limestone and Clays Ferry Formation make stratigraphic studies difficult as recurrence of lithologic types is common. Basing each type on mineral composition, grain size, sorting, bedding character, and relative abundance and degree of fragmentation of fossils, the eight most common are: calcarenite and calcirudite, tabular bedded micrograined limestone and shale, irregularly bedded to nodular fossiliferous limestone, nodular to irregularly fossiliferous limestone and shale, cryptograined (sublithographic) limestone, limy siltstone, limy dolomite, and interlacing cryptograined limestone and dolomite.—M.C.

**Black, R. F.** *See* Larochelle, A. 1137

**Black, Rudolph.** *See* Jordan, James, 1231

**Blakely, Robert F.** *See* Rudman, Albert J. 1217

1401 **Blecha, M.** Geology of the Tribag mine: Canadian Mining and Metall. Bull., v. 58, no. 642, p. 1077–1082, illus., 1965.

The Tribag copper deposit is one of the rare examples of mineralized breccia in the Canadian Shield. The breccia is a pipe like body, and consists of granitic, diabasic and volcanic fragments embedded in a vuggy, quartz-carbonate matrix. The mineralization is essentially chalcopyrite and pyrite, with minor molybdenite, sphalerite, galena and other sulphides. The main ore zone is saddle-like in shape, and is enveloped in a zone of chloritization, sericitization and clay mineral alteration. It is suggested that the breccia is of the diatreme type.—Author's abstract

1430 **Bloom, Arthur L.; Ellis, Charles W., Jr.** Postglacial stratigraphy and morphology of coastal Connecticut: Connecticut Geol. and Nat. History Survey Guidebook 1, 10 p., illus., tables, reprinted 1965; originally published 1963.

This report originally appeared as the Guidebook for Field Trip No. 5 of the 1963 Annual Meeting of the Geological Society of America, New York City. In the coastal area between Norwalk and Clinton three distinct stratigraphic records are produced by the reaction of sedimentation and submergence in three palludal environments: the estuarine "fresh water" marsh of Quinnipiac Valley; the deep bay or lagoon of Hammock River at Clinton; and the shallow marsh back of Chittendon Beach, Guilford. Gravel beaches and natural sand beaches between Norwalk and Westport are in a state of equilibrium, while those that are restored by direct fill disturb the equilibrium conditions and lose almost all traces of their "restoration" in two or three years.—G.D.C.

1282 **Bloomer, Richard R.** Vincent Charles Perini, Jr. (1895–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1537–1539, portrait, 1965.

1342 **Bold, W. A. van den.** Middle Tertiary Ostracoda from northwestern Puerto Rico: Micropaleontology, v. 11, no. 4, p. 381–414, illus., tables, 1965.

Sixty-seven species and four subspecies of ostracodes are described or listed from the middle Tertiary Isabela-San Sebastián section in northwestern Puerto Rico. Twelve species and two subspecies are new. The ostracodes suggest correlation of the San Sebastián Formation with the combined Vicksburg Group and Chickasawhay Formation in the Gulf Coast Oligocene, of the Lares Formation with the Paynes Hammock and Anahuac Formations of the Lower Miocene, and of the Cibao Formation with the Chipola Formation of Florida.—Author's abstract

1108 **Bolyard, Dudley W.; McGregor, Alexander A.** Stratigraphy and petroleum potential of Lower Cretaceous Inyan Kara Group in northeastern Wyoming, southeastern Montana, and western South Dakota [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1574, 1965.

1426 **Bond, T. A.** Recycled hystrichosphaerids in Pleistocene sediments in central Oklahoma: Oklahoma Geology Notes, v. 25, no. 5, p. 126–130, illus., 1965.

Several specimens of common Cretaceous hystrichospheres were found in samples of Pleistocene clay from ox-bow lake deposits along the Washita River, Okla. The fossils apparently were recycled from Cretaceous strata as a result of extensive erosion during the Wisconsin Glaciation. Hystrichospheres are protistan microscopic organisms, with characteristics suggesting close phylogenetic affinity to Protozoa, that occur mainly in marine shales and clayey or sandy limestones. The only Cretaceous marine rocks remaining in western Oklahoma are small outliers and sinkhole fillings; the hystrichospheres probably came from the Texas Panhandle area or the formerly extensive Cretaceous-Tertiary deposits in western Oklahoma.—M.C.

**Bonini, W. E.** *See* Gill, H. E. 1314

1351 **Bonini, William E.** Bouguer gravity anomaly map of New Jersey: New Jersey Geol. Survey Geol. Rept. Ser., no. 9, scale 1:250,000, 10 p., text, 1965.

A Bouguer gravity anomaly map of New Jersey, scale 1:250,000, is presented. It is based on over 4,000 gravity observations, half of which were previously unpublished. Contour interval is 5 mgal and the map is translucent, so that it can be used as an overlay on the State geologic map. A cross-section from Phillipsburg, N. J., to Barnegat Bay is given with Bouguer and isostatic anomalies shown. The trans-New Jersey gravity high is a marked positive Bouguer and isostatic anomaly and is related to basement or sub-basement density excess. The trans-New Jersey high is part of a series of gravity highs running from Georgia to Vermont and generally associated with the Piedmont Province south of New Jersey.—Author's abstract

1355 **Borgman, Leon E.** Upper bounds for damage due to geophysical hazards: Jour. Geophys. Research, v. 70, no. 20, p. 5313–5321, illus., tables, 1965.

Tables and graphs are presented for the 90th, 95th, and 99th percentiles of the total damage attributable to geophysical events (hurricanes, tornadoes, earthquakes) during a selected future interval of time. The underlying statistical model has the following properties: (1) Damaging events occur as a Poisson process with a time-varying instantaneous average. (2) The damage in each event is distributed independently and identically according to an incomplete gamma density. The use of the tables and graphs is illustrated with several numerical examples.—Author's abstract

1192 **Bostwick, David A.; Nestell, Merlynd K.** A new species of *Polydiexodina* from central Oregon: Jour. Paleontology, v. 39, no. 4, p. 611–614, illus., 1965.

*Polydiexodina oregonensis* n. sp., of late Guadalupe (late Permian) age is described from a float boulder in central Oregon. The boulder apparently came from nearby beds of boulder conglomerate of late Triassic age, of which most of the boulders contain the fusulinid fauna of the Coyote Butte Formation of Leonard (late early Permian) age. Uplift in the area during late Triassic time and removal of rocks of late Guadalupe age and a considerable thickness of beds of Leonard age are suggested.—Authors' abstract

1413 **Boyle, R. W.** Origin of the Bathhurst-Newcastle sulfide deposits, New Brunswick: Econ. Geology, v. 60, no. 7, p. 1529–1532, illus., 1965.

Massive sulfide veins in Silurian sediments and intrusive porphyry plugs are similar in mineralogy and chemistry to the banded massive sulfide deposits in the Ordovician volcanics and sediments. Conformity of some massive ore bodies is attributed to conformity of the structures they follow. The veins and some of the massive ore bodies are cross-cutting. Research to date suggests that deposits are late tectonic and epigenetic rather than deformed syngenetic.—W.S.W.

1346 **Bradley, Edward A.; Bennett, Theron J.** Earthquake history of Ohio: Seismol. Soc. America Bull., v. 55, no. 4, p. 745–752, illus., table, 1965.

Some 78 earthquakes occurring in Ohio in the years 1776 through 1964 have been tabulated. A literature search of newspapers and scientific journals was undertaken and a reasonably complete history from 1900 to the present may be assumed. The most prominent feature of the catalog is the high concentration of shocks in the Anna region. Certain geological trends are indicated, but evidence is inadequate to establish a definite correlation.—Authors' abstract

1269 **Brandon, L. V.** Groundwater hydrology and water supply in the District of Mackenzie, Yukon Territory, and adjoining parts of British Columbia: Canada Geol. Survey Paper 64-39, 102 p., illus., tables, 1965.

Ground water is effluent in regions of discontinuous permafrost in the Interior Plains and Cordillera, but flow in the Precambrian Shield is considered to be negligible. Where no piezometric data from borings is available, evidences of its movement are provided by winter base-flow records, chemical analyses of river waters, the presence of springs, and local halophytic flora. Quantitative information on its contribution to the Upper Liard basin is obtained from the relation between discharge and specific conductance. Several thermal springs in the Cordillera are

heated by deep circulation of meteoric waters, which may also contribute heat to sulfur springs. Ground water is available for domestic and community supplies in glaciated valleys of the Cordillera and in alluvium in other regions. Whitehorse and Dawson are the largest towns with well fields.—G.D.C.

1373 **Branson, Carl C.** *Petrodus* in Oklahoma: Oklahoma Geology Notes, v. 25, no. 10, p. 274–275, illus., 1965.

The fossil called *Petrodus* is abundant in some Pennsylvanian rocks in Oklahoma, having been reported from several formations and a number of localities. Originally named and described by McCoy (1848), shagreen granules of this type are so variable even in the skin of an individual shark that species are not useful. The Oklahoma forms range from symmetrical grooved cones to compound linear crowns, indicating in general a shallow, low-energy marine environment.—G.D.C.

**Brett, George W.** *See* Weld, Betsy A. 1139

1099 **Brewer, J. E.** Sedgwick basin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1561, 1965.

1009 **Briggs, R. P.; Mattson, P. H.; Glover, Lynn.** Copper impoverishment during successive igneous events in Puerto Rico—A clue to the origin of copper ore [abs.], *in* Cong. Latinoamericano Química, 9th, San Juan, Puerto Rico, 1965, Resumenes Trabajos: Río Piedras, Puerto Rico, Colegio de Químicos, p. 31–32, 1965.

1357 **Brokaw, A. L.; Shawe, D. R.** Geologic map and sections of the Ely 3 SW quadrangle, White Pine County, Nevada: U.S. Geol. Survey Misc. Geol. Inv. Map I-449, scale 1:24,000, 1965.

0996 **Bullard, Edward C.** Historical introduction to terrestrial heat flow, Chap. 1 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 1–6, 1965.

The first reference to high temperatures within the Earth known to the writer is by J. B. Morin in 1619; there is no known reference to the matter in the works of Agricola. Boyle, in 1671, raised many of the questions discussed in recent work. Little interest was taken in underground temperatures during the 18th century. The subject was energetically pursued by Committees of the British Association in 1868–1883 and 1935–1939. Measurements were first made at sea in 1950. In spite of the existence of about 2,000 measurements of heat flow, the temperatures deep within the Earth are still very uncertain. Observations of magnetic variations combined with the study of samples from Moholes may give better estimates. Author's abstract

1335 **Bullis, A. R.** Geology of Metal Mines, Ltd. (Bancroft Division): Canadian Mining and Metall. Bull., v. 58, no. 639, p. 713–721, illus., tables, 1965.

Uranium orebodies at Metal Mines Limited are in granite pegmatite in metamorphosed gnessic mid-Proterozoic limestone, amphibolite (metasediments), and clastic sediments that have been intruded by strongly differentiated felsic and mafic granitic rocks. Large, often irregular, masses of pegmatite were emplaced by intrusion, metasomatism, and magmatic stoping. Many contain vuggy cores. Ore shoots occur erratically in the pegmatite. Ore reserves are 453,000 tons containing 0.144 $U_3O_8$.—A.R.K.

1392 **Burkhart, Burke.** Geology of the Esquipulas, Chanmagua and Cerro Montecristo quadrangles, southeastern Guatemala [abs.]: Houston Geol. Soc. Bull., v. 8, no. 3, p. 17–18, 1965.

**Caballer de Pérez, Celeste.** *See* Ramírez Torres, Osvaldo. 1013

**Caballer de Pérez, Celeste.** *See* Ramírez Torres, Osvaldo. 1015

**Cabrera, Rosaida.** *See* Ramírez Torres, Osvaldo. 1013

1010 **Cadilla, José F.** Un estudio sobre arcillas de Puerto Rico, consideraciones químicas y mineralogías [abs.], *in* Cong. Latinoamericano Química, 9th, San Juan, Puerto Rico, 1965, Resumenes Trabajos: Río Piedras, Puerto Rico, Colegio de Químicos, p. 32, 1965.

1011 **Cadilla, José F.** Cobre en Puerto Rico—Consideraciones geológicas y químicas [abs.], *in* Cong. Latinoamericano Química, 9th, San Juan, Puerto Rico, 1965, Resumenes Trabajos: Río Piedras, Puerto Rico, Colegio de Químicos, p. 33–34, 1965.

1018 **Cahoon, Elizabeth Jerabek.** Lower Cretaceous pollen and spores from the southern Black Hills [abs.]: Dissert. Abs., v. 26, no. 2, p. 646, 1965.

**Callahan, J. A.** *See* Harvey, E. J. 1267

**Callahan, J. T.** *See* Wait, R. L. 1341

1174 **Calvin, Don G.** Incidence of oil and gas in the Cottage Grove Sandstone: Shale Shaker, v. 16, no. 2, p. 25–42, illus., 1965.

In southeastern Kansas the area referred to as the Cherokee Basin has undergone periods of intense oil and gas development, but reporting has not been updated with the improvement in geological techniques in the last 30 years. The vast potential that exists here can be shown, primarily by subsurface methods, when a systematic regional analysis of a correlatable lithologic unit is made. The Cottage Grove Sandstone, referred to by oil industry as "Layton" sand, is a member of the Chanute Shale which extends in the subsurface westward from its eastern outcrop to Harper County. Along with its related Kansas City Group it is the unit selected for this study; the details of the Kansas City Group facies are given, and the Cherokee basin evolution is summarized.—G.D.C.

1114 **Campau, Donald E.** Problems of correlating Permo–Triassic redbeds in Williston Basin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1573, 1965.

1069 **Canada Dept. Mines and Tech. Surveys.** Principal mineral areas of Canada: Canada Geol. Survey Map 900A, 15th ed., scale 1:7,603,200, 1965.

1070 **Canada Geological Survey.** Polar Continental Shelf Project, District of Franklin, Sheet 89 E/NE: Canada Geol. Survey Geophysics Paper 3427, scale 1:126,720, 1965.

1071 **Canada Geological Survey.** Polar Continental Shelf Project, District of Franklin, Sheet 89 A/NE and part of 89 A/NW: Canada Geol. Survey Geophysics Paper 3442, scale 1:126,720, 1965.

1275 **Canada Geological Survey.** Nova Scotia: Canada Geol. Survey Geol. Maps Index Sheet 20, scale 1:1,000,000, revised 1965.

1276 **Canada Geological Survey.** British Columbia–Alberta: Canada Geol. Survey Geol. Maps Index Sheet 82, scale 1:1,000,000, revised 1965.

1277 **Canada Geological Survey.** Yukon Territory–District of Mackenzie: Canada Geol. Survey Geol. Maps Index Sheets 107 and 117, scale 1:1,000,000, revised 1965.

1278 **Canada Geological Survey.** Newfoundland: Canada Geol. Survey Geol. Maps Index Sheet 1, scale 1:1,000,000, revised 1965.

1279 **Canada Geological Survey.** Ontario: Canada Geol. Survey Geol. Maps Index Sheet 42, scale 1:1,000,000, revised 1965.

1450 **Canada Geological Survey.** Aeromagnetic map, Kipahigan Lake, Saskatchewan–Manitoba: Canada Geol. Survey Geophys. Paper 2548, scale 1:63,360, 1965.

1451 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 N/12, Saskatchewan–Manitoba: Canada Geol. Survey Geophys. Paper 2549, scale 1:63,360, 1965.

1452 **Canada Geological Survey.** Aeromagnetic map, Britton Lake, Saskatchewan–Manitoba: Canada Geol. Survey Geophys. Paper 2550, scale 1:63,360, 1965.

1453 **Canada Geological Survey.** Aeromagnetic map, Sherridon, Manitoba: Canada Geol. Survey Geophys. Paper 2551, scale 1:63,360, 1965.

1454 **Canada Geological Survey.** Aeromagnetic map, Crow Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2552, scale 1:63,360, 1965.

1455 **Canada Geological Survey.** Aeromagnetic map, Morin Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2553, scale 1:63,360, 1965.

1456 **Canada Geological Survey.** Aeromagnetic map, Llama Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2554, scale 1:63,360, 1965.

1457 **Canada Geological Survey.** Aeromagnetic map, Batty Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2555, scale 1:63,360, 1965.

1458 **Canada Geological Survey.** Aeromagnetic map, Takipy Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2556, scale 1:63,360, 1965.

1459 **Canada Geological Survey.** Aeromagnetic map, Flatrock Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2557, scale 1:63,360, 1965.

1460 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 N/15, Manitoba: Canada Geol. Survey Geophys. Paper 2558, scale 1:63,360, 1965.

1461 **Canada Geological Survey.** Aeromagnetic map, Burntwood Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2560, scale 1:63,360, 1965.

1462 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 N/9, Manitoba: Canada Geol. Survey Geophys. Paper 2561, scale 1:63,360, 1965.

1463 **Canada Geological Survey.** Aeromagnetic map, Highrock, Manitoba: Canada Geol. Survey Geophys. Paper 2562, scale 1:63,360, 1965.

1464 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 J/4, Manitoba: Canada Geol. Survey Geophys. Paper 2563, scale 1:63,360, 1965.

1465 **Canada Geological Survey.** Aeromagnetic map, Hargrave Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2564, scale 1:63,360, 1965.

1466 **Canada Geological Survey.** Aeromagnetic map, Buzz Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2565, scale 1:63,360, 1965.

1467 **Canada Geological Survey.** Aeromagnetic map, Herb Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2566, scale 1:63,360, 1965.

1468 **Canada Geological Survey.** Aeromagnetic map, Wimapedi Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2567, scale 1:63,360, 1965.

1469 **Canada Geological Survey.** Aeromagnetic map, Driftwood River, Manitoba: Canada Geol. Survey Geophys. Paper 2568, scale 1:63,360, 1965.

1470 **Canada Geological Survey.** Aeromagnetic map, Apeganau Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2569, scale 1:63,360, 1965.

1471 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 O/13, Manitoba: Canada Geol. Survey Geophys. Paper 2570, scale 1:63,360, 1965.

1472 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 J/3, Manitoba: Canada Geol. Survey Geophys. Paper 2571, scale 1:63,360, 1965.

1473 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 J/6, Manitoba: Canada Geol. Survey Geophys. Paper 2572, scale 1:63,360, 1965.

1474 **Canada Geological Survey.** Aeromagnetic map, Ponton, Manitoba: Canada Geol. Survey Geophys. Paper 2573, scale 1:63,360, 1965.

1475 **Canada Geological Survey.** Aeromagnetic map, Saw Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2574, scale 1:63,360, 1965.

1476 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 O/3, Manitoba: Canada Geol. Survey Geophys. Paper 2575, scale 1:63,360, 1965.

1477 **Canada Geological Survey.** Aeromagnetic map, Wimapedi River, Manitoba: Canada Geol. Survey Geophys. Paper 2576, scale 1:63,360, 1965.

1478 **Canada Geological Survey.** Aeromagnetic map, Apeganau River, Manitoba: Canada Geol. Survey Geophys. Paper 2577, scale 1:63,360, 1965.

1479 **Canada Geological Survey.** Aeromagnetic map, Wapisu Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2578, scale 1:63,360, 1965.

1480 **Canada Geological Survey.** Aeromagnetic map, Kiskitto Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2579, scale 1:63,360, 1965.

1481 **Canada Geological Survey.** Aeromagnetic map, Hill Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2580, scale 1:63,360, 1965.

1482 **Canada Geological Survey.** Aeromagnetic map, Muhigan Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2581, scale 1:63,360, 1965.

1483 **Canada Geological Survey.** Aeromagnetic map, Pakwa Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2582, scale 1:63,360, 1965.

1484 **Canada Geological Survey.** Aeromagnetic map, Five Mile Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2583, scale 1:63,360, 1965.

1485 **Canada Geological Survey.** Aeromagnetic map, Tullibee Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2584, scale 1:63,360, 1965.

1486 **Canada Geological Survey.** Aeromagnetic map, Wuskwatim Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2585, scale 1:63,360, 1965.

1487 **Canada Geological Survey.** Aeromagnetic map, Nelson House, Manitoba: Canada Geol. Survey Geophys. Paper 2586, scale 1:63,360, 1965.

1488 **Canada Geological Survey.** Aeromagnetic map, Kiskittogisu Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2587, scale 1:63,360, 1965.

1489 **Canada Geological Survey.** Aeromagnetic map, Metchanais Rapids, Manitoba: Canada Geol. Survey Geophys. Paper 2588, scale 1:63,360, 1965.

1490 **Canada Geological Survey.** Aeromagnetic map, Drunken Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2589, scale 1:63,360, 1965.

1491 **Canada Geological Survey.** Aeromagnetic map, Duck Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2590, scale 1:63,360, 1965.

1492 **Canada Geological Survey.** Aeromagnetic map, Halfway Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2591, scale 1:63,360, 1965.

1493 **Canada Geological Survey.** Aeromagnetic map, Hambone Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2592, scale 1:63,360, 1965.

1494 **Canada Geological Survey.** Aeromagnetic map, Ospwagan Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2593, scale 1:63,360, 1965.

1495 **Canada Geological Survey.** Aeromagnetic map, Sheet 63 O/16, Manitoba: Canada Geol. Survey Geophys. Paper 2594, scale 1:63,360, 1965.

1496 **Canada Geological Survey.** Aeromagnetic map, Pine Creek, Manitoba: Canada Geol. Survey Geophys. Paper 2595, scale 1:63,360, 1965.

1497 **Canada Geological Survey.** Aeromagnetic map, Sugar Falls, Manitoba: Canada Geol. Survey Geophys. Paper 2596, scale 1:63,360, 1965.

1498 **Canada Geological Survey.** Aeromagnetic map, Cross Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2597, scale 1:63,360, 1965.

1499 **Canada Geological Survey.** Aeromagnetic map, Hill Rapids, Manitoba: Canada Geol. Survey Geophys. Paper 2598, scale 1:63,360, 1965.

1500 **Canada Geological Survey.** Aeromagnetic map, Sipiwesk Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2599, scale 1:63,360, 1965.

1501 **Canada Geological Survey.** Aeromagnetic map, Wintering Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2600, scale 1:63,360, 1965.

1502 **Canada Geological Survey.** Aeromagnetic map, Thompson, Manitoba: Canada Geol. Survey Geophys. Paper 2601, scale 1:63,360, 1965.

1503 **Canada Geological Survey.** Aeromagnetic map, Mystery Lake, Manitoba: Canada Geol. Survey Geophys. Paper 2602, scale 1:63,360, 1965.

1504 **Canada Geological Survey.** Aeromagnetic map, Paimusk Creek, Manitoba: Canada Geol. Survey Geophys. Paper 2603, scale 1:63,360, 1965.

**Caner, B.** *See* Lambert, A. 1311

1083 **Canney, F. C.** Geochemical prospecting investigations in the Copper Belt of Vermont: U.S. Geol. Survey Bull. 1198-B, p. B1-B28, illus., tables, 1965.

Results are discussed of geochemical prospecting in the Copper Belt of Orange County, Vt., in the dissected uplands of west central New England. Ores are chiefly pyrrhotite with some chalcopyrite and sphalerite. Most of the studies were in the area of the Elizabeth mine. Anomalous patterns of copper and zinc are present in the B zone of soils over and adjacent to near-surface pyrrhotitic copper deposits concealed by a thin mantle of glacial till. At the Elizabeth mine anomalies are highly skewed in the direction of ice movement and were formed by the mechanical dispersion by glacial ice of a preglacial copper-rich residual soil. Soil sampling appears to be an effective way of prospecting for such deposits.—W.L.G.

1332 **Cardwell, G. T.** Geology and ground water in Russian River valley areas and in Round, Laytonville, and Little Lake Valleys, Sonoma and Mendocino Counties, California: U.S. Geol. Survey Water-Supply Paper 1548, 154 p., illus., tables, 1965.

This report describes the occurrence, availability, and quality of ground water in seven valley areas along the course of the Russian River in Sonoma and Mendocino Counties, Calif., and in three valleys in the upper drainage reach of the Eel River in Mendocino County. . . . Selected descriptions of wells, drillers' logs, chemical analyses, and hydrographs showing water-level fluctuations are included. Accompanying maps show the distribution of water-bearing formations and the location of wells.—Author's abstract

1336 **Carlisle, Donald; Susuki, Takeo.** Structure, stratigraphy, and paleontology of an Upper Triassic section on the west coast of British Columbia: Canadian Jour. Earth Sci., v. 2, no. 5, p. 442-485, illus., tables, 1965.

The highly deformed section at Open Bay, Quadra Island, is one of a few good exposures of a thick sedimentary unit within the prebatholithic rocks along the coast. It provides new structural data relating to emplacement of a part of the Coast Range batholith and contains an important Upper Triassic fauna, 13 ammonite genera from 14 localities as the *Tropites subbullatus* zone. The Open Bay Formation is recrystallized limestone and interbedded pillow lava. The beds are lithologically similar across the whole area except for variations in intensity of deformation and

thermal alteration. Predominant folding is shown to precede, accompany, and follow intrusion of numerous andesitic pods and to precede emplacement of quartz diorite of the batholith. Structural asymmetry originated from gentle cross-folding and emplacement of minor intrusives during deformation.—M.C.

1374 **Carlisle, Victor W.** Electron micrographs of clays in Florida soils: Soil and Crop Sci. Soc. Florida Proc. 1964, v. 24, p. 89–99, illus., 1965.

Clay fractions in Weston loamy fine sand in Baker and Duval Counties, Blanton and Leon fine sands in Nassau County, Tifton loamy fine sand in Gadsden County, Red Bay fine sandy loam in Santa Rosa County, and Goldsboro loamy sand in Washington County were studied and compared with standard samples of kaolinite, gibbsite, halloysite, montmorillonite, and attapulgite. Soil clays rarely attained the same degree of crystal perfection as the reference minerals; the small size and irregular crystal morphology probably resulted from release of aluminum by severe weathering. No attapulgite or montmorillonite was recognized. Clay minerals in the soils could be detected by the electron microscope even when they occurred in amounts below the limit of detectability by X-ray diffraction and DTA techniques.—M.C.

**Carlisle, Victor W.** *See* Fiskell, John G. A. 1375

1283 **Carlson, Charles G.; Clark, Frank R.; Berry, Frederick A. F.** Arville Irving Levorsen (1894–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1534–1537, portrait, 1965.

**Carlson, Thomas C.** *See* Little, Curtis J. 1148

**Carpenter, Robert Heron.** *See* Desborough, George A. 1418

1271 **Carr, Donald D.** (compiler) Locations of sand and gravel operations in Indiana: Indiana Geol. Survey Misc. Map 10, scale 1:1,000,000, 1964.

1031 **Carrington, Thomas Jack.** Stratigraphy and petrography of the Iron Mountain Formation (basal part of the Unicoi Group) in southwestern Virginia [abs.]: Dissert. Abs., v. 26, no. 2, p. 982, 1965.

1157 **Cauthen, Lewis J., Jr.** Project Pre-Schooner-Strong seismic measurements: California Univ. Lawrence Radiation Lab., Livermore, Calif., Rept. PNE-504F, 31 p., illus., tables, 1965.

Strong motion seismograph stations were operated by the U.S. Coast and Geodetic Survey during the four Pre-Schooner cratering experiments conducted in basalt on Buckboard Mesa. The purpose was to study ground shock resulting from small-scale cratering detonations in hard rock; surface acceleration and displacement time were recorded for each detonation. Results indicate that ground shock resulting from detonations of a 20-ton high range chemical explosive differed from that observed in larger yield nuclear explosions. The most significant difference was in the attenuation rate of surface acceleration, which was higher for the Pre-Schooner than for observed nuclear detonations; surface displacements were also higher.—M.C.

**Chinnery, M. A.** *See* Grant, F. S. 1312

**Cinnamon, C. G.** *See* Doman, R. C. 1184

1032 **Cisternas, Armando.** Pt. 1—The radiation of elastic waves from a spherical cavity in a half space; Pt. 2—Precision determination of focal depths and epicenters of earthquakes [abs.]: Dissert. Abs., v. 26, no. 2, p. 982–983, 1965.

**Clark, Frank R.** *See* Carlson, Charles G. 1283

**Clarke, D. B.** *See* Wilson, J. Tuzo. 1368

1410 **Clayton, John Mason.** Paleodepositional environments of the "Cherokee" sands of central Payne County, Oklahoma: Shale Shaker, v. 16, no. 3, p. 50–66, illus., 1965.

A dendritic pattern of erosion on Mississippian limestones, exposed during Early Pennsylvanian time, influenced deposition of the "Cherokee" sands. These sands, mostly of channel and sheet type, are characterized from east to west by alternating transgressive and regressive lithologies; sand of Red Fork age largely follows drainage channels on the pre-Desmoinesian surface. The stratigraphic and structural traps in the Cherokee sandstones account for over half of the oil production in central Payne County. Thick deposition in channel areas sometimes resulted in formation of anticlinal compaction folds above them. The Stillwater field is an example of such paleoenvironments, and the stratigraphic principles can be applied to future exploration.—G.D.C.

1203 **Cobb, James C.; Moran, George.** Gallium concentrations in the metal phases of various meteorites: Jour. Geophys. Research, v. 70, no. 20, p. 5309–5311, table, 1965.

Neutron activation analysis of the metal phases of 7 chondrites and 14 iron meteorites shows that Ga is quite uniform in ordinary H- and L-group chondrites, averaging 12 ppm, whereas the metal phase of the Abee enstatite chondrite contains 64 ppm. A previously established distribution of Ga abundances in iron meteorites around certain unique values is postulated to be related to the origin of iron meteorites. There is no correspondence, however, between the Ga group and cosmic ray exposure age.—D.B.V.

1367 **Colinvaux, Paul A.** Pollen from Alaska and the origin of ice ages [reply to comments on 1964 paper by W. L. Donn and Maurice Ewing, 1965]: Science, v. 147, no. 3658, p. 633, illus., table, 1965.

In reply to Donn and Ewing's comments (Science, v. 147, no. 3658, p. 632, 1965) Colinvaux asserts that his data (Science, v. 145, no. 3633, p. 707–708, 1964) were based not only on pollen but also on radiocarbon analyses, and suggest very strongly that the Arctic Ocean has been continuously frozen for the last 30,000 years. D.B.V.

1057 **Colvin, John M., Jr.; Marcher, Melvin V.** Geologic map of the Gordonsburg quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 50-SW, scale 1:24,000, separate text, 1964.

Resources of the Gordonsburg quadrangle are chert, iron ore, phosphate, and a limited amount of limestone. Chert is residual material derived from the Fort Payne, Warsaw, and St. Louis Formations (Mississippian). Iron ore is found in Mississippian residuum on and under remnants of an erosional surface; deposits are sporadic and pockety and their elevation ranges from 740 to 985 feet. The blue phosphate deposits generally compact and bedded, range from zero to 30 inches thick at the base of the Chattanooga Shale. All known mines and commercial deposits occur where the phosphate is underlain directly by the Leipers Limestone.—M.C.M.

1249 **Colvin, John M., Jr.** Mineral resources summary of the Littlelot quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 14 p., 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 49-SE, by C. W. Wilson, Jr. et al (cited separately), and describes the chert, iron ore, and phosphate found in the Littlelot quadrangle. The iron ore deposits are located on or near the crests and spurs of ridges in the northeastern and east-central parts of the area, in Mississippian residuum on and under remnants of the erosional surface between the Mississippian and the Tuscaloosa Formation; deposits and occurrences are sporadic and pockety. All known brown phosphate deposits and mines are within the area of distribution of the Leipers and Bigby-Cannon Limestones. The base of the Chattanooga Shale should be prospected for blue phosphate. Chert in the area is residual material derived from the Mississippian Fort Payne, Warsaw, and St. Louis Formations.—M.C.M.

**Colvin, John M., Jr.** *See* Wilson, Charles W., Jr. 1290

**Compston, W.** *See* Murthy, V. Rama. 1412

1133 **Conley, Curtis D.** Petrology of the Leadville Limestone (Mississippian), White River Plateau, Colorado [abs.]: Mtn. Geologist, v. 2, no. 3, p. 181–182, 1965.

1350 **Connolly, Edward T.** First handbook of production logging—Pt. 1, Physical measurements: Canadian Petro Eng., v. 6, no. 7, p. 63–72; Pt. 2, Fluid measurements, ibid., no. 8, p. 15, 17–26, 28; Pt. 3, Flow characteristics, Canadian Petroleum, v. 6, no. 9, p. 14–17, 19, 21–23; Pt. 4, Diagnosis and evaluation of fluids, ibid., no. 10, p. 72–76, illus., tables, 1965.

This series of articles shows through short, non-technical descriptions and examples, and by discussion of their limitations, ways and means of using production-logging tools. Production well-logging is classified in two groups. The first, physical measurements (part 1) covers all logs used to describe physical conditions in the borehole and adjacent formations and includes open-hole data as well as data on casing, cement tops, cement quality and the like. The second, fluid measurement (parts 2–4), covers all logs and devices used to determine rate, direction, quantity and identity of fluids within and around the borehole. This second group is subdivided into flow characteristics and diagnosis and evaluation.—V.S.N.

1136 **Conolly, John R.; Ewing, Maurice.** Pleistocene glacial-marine zones in North Atlantic deep-sea sediments: Nature, v. 208, no. 5006, p. 135–139, illus., table, 1965.

It is shown that the abundance and distribution of ice-rafted detritus in deep-sea cores in the North Atlantic could provide a powerful tool for delineating even minor fluctuations in the Pleistocene climate, and possibly for determining the Pliocene-Pleistocene boundary using as a criterion the appearance of the first ice-rafted detritus in deep-sea pelagic cores.—D.B.V.

1199 **Cooper, James B.** Ground-water resources of the northern Tularosa basin near Carrizozo, Lincoln County, New Mexico: U.S. Geol. Survey Hydrol. Inv. Atlas HA-193, scale about 1 in to 3 mi, text, 1965.

Northern Tularosa basin near Carrizozo is underlain by eastward-dipping Permian, Triassic, Cretaceous, and Tertiary(?) sedimentary rocks, which have been intruded in many places by igneous rocks and overlain in part by Tertiary and Quaternary volcanic rocks; these formations, the Quaternary alluvium, and the Malpais basalt flow are described. The best aquifer is Quaternary alluvium which is partly saturated and will yield fairly large quantities of water. Sandstone beds in the underlying Cretaceous rocks form a more widespread aquifer which yields small quantities of water. Generally both aquifers yield water of inferior quality, the most objectionable constituents being sulfate and chloride.—M.C.M.

1301 **Copeland, David A.** A simple apparatus for trimming thin sections: Am. Mineralogist, v. 50, nos. 7–8, p. 1128–1130, illus., 1965.

The apparatus described and illustrated, a metal holder for glass slide and mounted rock chip, is designed to be hand-fed, thus allowing the operator to sense cutting resistance and adjust feed rate accordingly. The slide is held in a recess by a vacuum against an O-ring seal. Chips can be cut to a thickness of 60 microns or less in less than a minute; shop cost was thirty dollars.—B.C.H.

1347 **Corwin, Gilbert; Weed, E. G. A.** Results of 1965 nationwide geology examination offered by United States Civil Service Commission: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1518–1519, illus., tables, 1965.

Of the 521 persons who took the written examination in 1965, 174 (or 33 percent) passed; in the preceding 10 yr period, 21 percent of all examinees passed. A frequency distribution curve of adjusted scores for the passing group and tables of level of education of examinees and ranking of geographic areas by number of examinees receiving geologic training in each area are included.—M.C.M.

1402 **Cotter, R. D.; Young, H. L.; Petri, L. R.; Prior, C. H.** Ground and surface water in the Mesabi and Vermilion Iron Range area, northeastern Minnesota: U.S. Geol. Survey Water-Supply Paper 1759-A, p. A1-A36, illus., tables, 1965.

Within the Mesabi-Vermilion Iron Range area, water of good quality is available from the Biwabik Iron-Formation, from stratified drift, and from lakes and streams. Single wells in the Precambrian Biwabik Iron-Formation have yielded 1,000 gpm; in Pleistocene stratified drift they have yielded up to 2,000 gpm. Streams drain about 700 billion gallons per year from the area. The lakes cover about 5 percent of the area. Optimum development of the water resources might be achieved by using streamflow in the spring and summer and ground-water and surface-water storage in the fall and winter.—W.L.G.

1104 **Covington, Robert E.; McDonald, Ralph L.** Stratigraphic and structural controls of bituminous sandstone deposits of Utah [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1577, 1965.

1391 **Crane, David C.** Geology of the Jocotan and Timushan quadrangles, southeastern Guatemala [abs.]: Houston Geol. Soc. Bull., v. 8, no. 3, p. 18-19, 1965.

1259 **Crawford, F. D.** Biostratigraphy of Santa Maria area [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 7, p. 1083, 1965.

1033 **Crawford, William Arthur.** Studies in Franciscan metamorphism near Jenner, California [abs.]: Dissert. Abs., v. 26, no. 2, p. 983, 1965.

**Cromer, Don T.** *See* Larson, Allen C. 1264

1247 **Cronquist, Arthur.** The status of the general system of classification of flowering plants: Missouri Bot. Garden Annals, v. 52, no. 3, p. 281-303, 1965.

The status of classification of angiosperms is reviewed. The Englerian system is obsolescent, as it fails to recognize significance of reduction and therefore equates the simple with the primitive; most Englerian families can stand with little change, but the higher taxa must be largely recast. Any acceptable new system must be based on the Ranalian concept of angiosperm evolution, the monocots being derived from primitive dicots. The angiosperms were probably derived from seed ferns, Cycadophyta. The fossil record provides little assistance in clarifying ancestry and interrelationships of angiosperms; herbs do not become a prominent part of the fossil record until the beginning of the Miocene, whereas woody groups extend back at least to the Cretaceous.—V.M.J.

1243 **Dalquest, W. W.** A turntable for examining small fossils under the microscope: Soc. Vertebrate Paleontology News Bull. 75, p. 51, illus., 1965.

A simple turntable can be constructed quickly and cheaply for examination of teeth and jaws of small mammals without excessive handling. The base is made of half a plastic table-tennis ball filled with plaster and glued flat side down to a small fiberboard square. The table is made of a portion of the remaining hemisphere with a one-inch square of thin fiberboard glued to the top. The fossil is placed on a small blob of beeswax centered on the fiberboard, and the table is placed, cuplike, over the base. Under the microscope the table can be rotated or tilted to examine top and sides of the specimen. The table is easily lifted off, leaving the heavy base centered under the lens.—V.M.J.

1422 **Dalrymple, G. Brent; Hirooka, Kimio.** Variation of potassium, argon, and calculated age in a late Cenozoic basalt: Jour. Geophys. Research, v. 70, no. 20, p. 5291-5296, illus., tables, 1965.

Repetitive K-Ar age determinations on whole-rock samples from a Late Cenozoic basalt (from the Benton Range, California) give a standard deviation of precision of about 2 percent; K analyses of 10 chips from one hand specimen give a total spread of 3.11 percent and $\sigma = 0.93$ percent, and 12 Ar analyses give a total spread of 6.76 percent and $\sigma = 1.84$ percent. The within-sample calculated ages give a mean value of 3.42 m.y. with total spread of 7.60 percent and $\sigma = 1.90$ percent. Calculated

ages of 7 samples collected nearly 3 km apart average 3.32 m.y. with total spread of 6.33 percent and $\sigma = 2.11$ percent; the total spread in the K and Ar values from these samples, however, is more than 20 percent.—D.B.V.

**Damon, Paul E.** *See* Mauger, Richard L. 1409

1208 **Dauvillier, Alexander.** The photochemical origin of life (translated from French by Scripta Technica, Inc.): New York, Academic Press, 193 p., illus., table, 1965 originally published 1958.

This theory of the origin of life, worked out by the author and Dr. E. Desguin in 1938, is the subject of several books in French. The first English translation presented here includes a number of new facts that were not given in the original text published in 1958 by Masson of Paris. Professor Dauvillier's theory explains the origin of life as an interdisciplinary problem of cosmic physics involving astronomy, geophysics, and geochemistry. He shows that cosmic paleovulcanism played an important role by bringing about pyrogenetic synthesis of numerous heterocyclic compounds; after condensation of the oceans, photochemical reactions occurred that were capable of creating the optical rotation characteristic of living matter.—G.D.C.

1227 **Davidson, J. L., Jr.** Ben A. Elmdahl (1920–1965): Houston Geol. Soc. Bull., v. 8, no. 2, p. 19–20, 1965.

**Dawson, K. R.** *See* Maxwell, J. A. 1431

**Delavault, R. E.** *See* Warren, H. V. 1444

1418 **Desborough, George A.; Carpenter, Robert Heron.** Phase relations of pyrrhotite: Econ. Geology, v. 60, no. 7, p. 1430–1450, 1965.

A tentative phase diagram for the system FeS–$FeS_2$ shows the pyrite–pyrrhotite solvus termination downward at a nearly isothermal phase boundary near 315°C. Above this boundary, hexagonal pyrrhotite has a supercell in which $a = 2A$, $c = 7C$, not previously recognized. Immediately below this boundary, hexagonal pyrrhotite (supercell with $a = 2A$, $c = 5C$) occupies most of the field between 46.6 and 50 percent Fe. This field decreases downward, between a narrow two-phase field with monoclinic pyrrhotite (stoichiometric $Fe_7S_8$) on one side, and a low-temperature (<140°C) two-phase field with troilite on the other. The numerous processes that may affect the composition of pyrrhotite with pyrite limit the reliability of the pyrrhotite geothermometer.—W.S.W.

1411 **Deutsch, E. R.** The paleolatitude of Tertiary oil fields: Jour. Geophys. Research, v. 70, no. 20, p. 5193–5203, illus., tables, 1965.

Paleolatitudes ($\lambda_p$) of 50 prominent Oligocene, Miocene, and Pliocene oil fields have been estimated from published paleomagnetic data. The present mean latitude ($\lambda$) is 35.6° N. and the mean $\lambda_p$ is 30.0° N. Half the fields are in Europe, Asia, and Africa, with mean $\lambda = 39.7°$ N. and mean $\lambda_p = 28.6°$ N.; the others are in the United States, where there is no significant difference between $\lambda$ and $\lambda_p$. All 24 latitude changes since Tertiary were northward and are attributed to late Cenozoic polar wandering or continental drift. For Paleozoic reservoirs $\lambda_p$ is usually less than 20°. If high temperature was critical in oil formation and migration was not a serious factor, Tertiary hot-climate belts may have been broader than today's.—D.B.V.

1349 **Dillon, E. L.; Nichols, C. W.** Handling of statistical well data by computer: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1520–1531, illus., table, 1965.

A computer system to store, retrieve, and tabulate oil-well data for use in the exploration summary papers published each June in this Bulletin is described. The system is recommended as a model for handling basic statistical data by the industry as a whole. Copies of the master magnetic tape reel are available from the Association.—V.S.N.

1251 **Dodson, Chester L.; Harris, Wiley F., Jr.; Warman, James C.** Geology and ground-water resources of Morgan County, Alabama, with a section on the chemical quality of the water: Alabama Geol. Survey Bull. 76, 90 p., illus., tables, geol. map, 1965.

In Morgan County the principal aquifers are in seven Mississipian and one Pennsylvanian formations. These are described and their outcrops shown on a geologic map. Ground water occurs chiefly in solution cavities and fractures in the Tuscumbia Limestone and Fort Payne Chert, of which only a small part of the aquifer is developed. Wells that will yield 100 gpm or more from these two formations are common in the Tennessee Valley physiographic district. Similar yields could be obtained in the Moulton Valley. The largest yield is estimated to be about 1,100 gpm, from the Fort Payne Chert. Chemical quality is generally suitable for most uses.—G.D.C.

1184 **Doman, R. C.; Cinnamon, C. G.; Bailey, S. W.** Structural discontinuities in the plagioclase feldspar series: Am. Mineralogist, v. 50, nos. 5-6, p. 724-740, illus., tables, 1965.

. . . In the plot of reciprocal angle $\gamma^*$ relative to $\alpha$ refractive index, experimental points for plagioclases in low structural state lie on linear segments separated from one another by discontinuities near $An_{33}$, $An_{50}$, and $An_{90-95}$. The discontinuities show up in plots of the $\gamma^*$ angle and positions of non-Bragg subsidiary reflections as functions of individual grain compositions. Along each segment Ca and Al substitute randomly for Na and Si over one or more, but not all, available sets of atomic positions. At compositions providing simple Na:Ca and Si:Al ratios reorganization takes place to provide ordering of Na and Ca and regular alternation of Si and Al over as many sets of tetrahedral positions as allowed by composition and symmetry. $An_{90-95}$ represents the boundary between transitional and primitive anorthite.—from Authors' abstract

**Domenico, P. A.** *See* Mifflin, M. D. 1140

1366 **Donn, William L.; Ewing, Maurice.** Pollen from Alaska and the origin of ice ages [discussion of paper by Paul Colinvaux, 1964]: Science, v. 147, no. 3658, p. 632, 1965.

According to the modified form of Ewing and Donn's theory, continental glaciation culminated 18,000 yr ago, rather than 11,000, and the Arctic Ocean would have frozen over well before that. Rather than negating the theory (which requires an open Arctic Ocean to initiate glaciation but allows it to freeze later), Colinvaux's data and conclusions (Science, v. 145, no. 3633, p. 707-708, 1964) support it in its modified form.—D.B.V.

1130 **Donnell, John R.** Geology and oil shale resources of the Green River Formation: Mtn. Geologist, v. 2, no. 3, p. 95-102, illus., reprinted 1965; originally published 1964.

The Green River Formation was deposited in three Eocene lakes that covered an area of more than 34,000 sq mi in Colorado, Utah, and Wyoming. They were Lake Gosiute, which occupied what are now called the Green River, Great Divide, Washakie, and Sand Wash Basins, Lake Uinta, which occupied the area of the present Piceance Creek and Uinta Basins, and a smaller lake occupying what is now Fossil Basin in Wyoming. The extensive oil-shale deposits are thickest and richest near the center of the depositional basin reaching a maximum thickness of 2,000 feet in Piceance Creek Basin in Colorado. The shale contains more than 2 trillion bbl of oil and yields more than 10 gal oil per ton. About 80 percent is in the Colorado Piceance Creek Basin, 15 in the Uinta Basin, Utah, and 5 in the Green River Basin, Wyoming.—M.C.

1256 **Dort, Wakefield, Jr.; Zeller, E. J.; Turner, M. D.; Vaz, J. E.** Paleotemperatures and chronology at archeological cave site revealed by thermoluminescence: Science, v. 150, no. 3695, p. 480-481, illus., 1965.

Contrasting values of remanent thermoluminescence of limestone samples from Jaguar Cave, eastcentral Idaho, reveal temperature differences attributable to position within the cave microenvironment. Absence of recorded temperature change during cave filling by rock and human debris indicates brevity of human occupation, which was near the end of Wisconsin (Pinedale) time.—Authors' abstract

1363 **Douglas, Archibald G.; Main, Beveridge J.** Sulfur—Role in genesis of petroleum: Science, v. 147, no. 3657, p. 499–501, illus., 1965.

The products of the reactions of sulfur with cholesterol at 150°C and with farnesol at 135°C suggest that a thermal reaction of sulfur with terpinoids and steroids at such relatively low temperatures plays a part in the genesis of petroleum.—D.B.V. 1003

1082 **Durham, David L.** Geology of the Jolon and Williams Hill quadrangles, Monterey County, California: U.S. Geol. Survey Bull. 1181-Q, p. Q1–Q27, illus., tables, geol. maps, 1965.

The Jolon and Williams Hill quadrangles include part of the drainage areas of the San Antonio and Nacimiento Rivers, two major western tributaries of the Salinas River. The sedimentary rocks that crop out in the map area are of Paleocene(?), Miocene, and Pleistocene age. They comprise six mappable units that probably have a combined maximum thickness greater than 12,000 feet. Two small areas of pre-Tertiary basement plutonic rocks crop out near the Nacimiento River and in 13 wells in Williams Hill quadrangle. Major structural features trend northwest.—W.L.G.

1296 **Eales, H. V.** Polarization figures as an aid to identification of polished isotropic minerals: Am. Mineralogist, v. 50, nos. 7–8, p. 942–952, illus., tables, 1965.

The azimuth of vibration of plane-polarized light falling obliquely on a polished surface is rotated on reflection. This rotation can be measured with a conventional ore microscope calibrated for the purpose, giving the refractive index of transparent isotropic minerals within 0.05. Use of a compensator for measuring the ellipticity of the reflected light in the polarization figure yields a rapid method for approximate determination of the absorption and refractive indices of opaque minerals. These data may aid mineral identification during routine examination of polished ores.—Author's abstract 1406

**Eaton, F. M.** *See* Tixier, M. P. 1193

1328 **Edgar, A. D.** The mineralogical composition of some nepheline alteration products: Am. Mineralogist, v. 50, nos. 7–8, p. 978–989, tables, 1965. 1073

Sixteen samples of variously labelled alteration products of nepheline, principally "hydronephelites" and "ranites", have been examined by X-ray diffraction methods. The majority of these samples consist mainly of natrolite, a phase resembling the "anhydrous" natrolite of Peng (1955) and a variety of minor minerals. In view of the discrepancies between the data of Peng (1955) and Fang (1963), it is suggested that this "anhydrous" natrolite does not in fact represent a dehydrated form of natrolite. The X-ray patterns indicate no lines corresponding to the synthetic nepheline hydrates and it is concluded, both from experimental and theoretical considerations, that "hydronephelites" and "ranites" are not the natural analogues of these synthetic products.—Author's abstract 1068

1117 **Edwards, Stanley M.** Permo-Pennsylvanian oil traps of western Powder River Basin, Wyoming [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1573, 1965.

**Ehlers, E. G.** *See* Schopf, J. M. 1198

1245 **Eicher, Don L.** Cretaceous tintinnids from the western interior of the United States: Micropaleontology, v. 11, no. 4, p. 449–456, illus., 1965.

Several hundred specimens of Tintinnina (Protozoa, subphylum Ciliophora) have been recovered, as crushed loricas 0.09–0.30 mm long, from the Albian, Thermopolis, and Nefsy Shales and from the Cenomanian Graneros Shale in Wyoming, South Dakota, and Colorado. Of the six species, all new, five are referred to the modern genera *Tintinnopsis*, *Codonella*, and *Coxliella*; *Dicloeopella borealis* is assigned to a new genus. These are the first fossil tintinnids reported from the United States; they are younger than any fossil forms except a Quaternary species from Scandinavia. Most were associated with arenaceous benthonic Foraminifera suggestive of marginal or shallow marine environments, in contrast to the inferred deep-water Mesozoic faunas of the Mediterranean region.—V.M.J.

1003 **Elder, John W.** Physical process in geothermal areas, Chap. 8 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 211–239, illus., table, 1965.

The role of movement of water and, to a lesser extent, magma in the flow of heat within the Earth, in or just below the crust, is considered. . . . At the surface, heat flow is discharged as radiation, by warming the ambient air or water, or as water vapor produced by flashing or by evaporation at the water table. The water-vapor mechanism predominates in land thermal areas. . . . Beneath land thermal areas, a body of freely circulating hot water is identified and discussed in terms of convection in a porous medium. Such a hydrothermal system can transfer heat several orders of magnitude faster than thermal conduction. Model experiments are compared with the Taupo hydrothermal systems of New Zealand. Thermal areas derive their energy from sources at depth. It is suggested that these sources arise from the upper mantle by penetrative convection. Within the lower mantle a highly disordered free convective motion is envisaged.—Author's abstract

**Ellis, Charles W., Jr.** *See* Bloom, Arthur L. 1430

1406 **Elsaharty, A. F.; Grant, F. S.** On the regionality of isostasy in the Canadian Cordillera: Canadian Jour. Earth Sci., v. 2, no. 5, p. 411–417, illus., 1965.

A gravity survey was made in 1961 across the Canadian Cordillera from Lethbridge, Alberta, to Hope, British Columbia. It covered a distance of 500 mi, crossed a variety of geological boundaries, and encompassed a vertical range of over 6,000 feet. Gravity observations were taken at 3–4 mi intervals, and isostatic reduction and interpretation of the measurements showed that compensation beneath this massif is regional rather than local. Using Vening-Meinesz tables, values of 30 km and 116 km respectively were found for $T$ (mean crustal thickness) and $R$ (radius of regionality). The values imply a mean crustal rigidity comparable in magnitude with values determined from seismology and from postglacial rebound.—M.C.

1073 **Elsik, William Clinton.** Palynology of the Lower Eocene Rockdale Formation, Wilcox Group, Milam and Robertson counties, Texas [abs.]: Dissert. Abs., v. 26, no. 1, p. 311, 1965.

1068 **Emslie, Ronald F.** The Michikamau anorthositic intrusion, Labrador: Canadian Jour. Earth Sci., v. 2, no. 4, p. 385–399, illus., tables, 1965.

The intrusion is a large, unmetamorphosed mass, which according to K-Ar dating of biotite crystallized about 1,400 m.y. ago. The main rock units are leucotroctolite, anorthosite, and leucogabbro and the essential minerals, plagioclase, olivine, clinopyroxene, and orthopyroxene. This typical large, layered basic pluton has olivine basalt in the chilled margin and highly feldspathic bulk composition for the mass, probably implying that the basaltic liquid was highly charged with plagioclase. Bottom accumulation of crystals appears to have been important in differentiation and solidification of the intrusion. Magmatic differentiation tended toward extreme iron enrichment with development of ferrous-rich dioritic, granodioritic, and syenitic rocks as end products.—M.C.

**Engel, A. E. J.** *See* Tatsumoto, M. 1258

**Evans, Howard T., Jr.** *See* Appleman, Daniel E. 1404

**Ewing, Maurice.** *See* Conolly, John R. 1136

**Ewing, Maurice.** *See* Sykes, Lynn R. 1356

**Ewing, Maurice.** *See* Donn, William L. 1366

**Farquhar, R. M.** *See* Kanasewich, E. R. 1067

**Farvolden, R. N.** *See* Maxey, G. B. 1313

**Ferguson, S. A.** *See* Gross, W. H. 1334

1141 **Finch, William Anderson, Jr.** The karst landscape of Yucatan [abs.]: Dissert. Abs., v. 26, no. 2, p. 978–979, 1965.

**Finlayson, C. Pratt.** *See* Marcher, Melvin V. 1396

**Finlayson, C. Pratt.** *See* Lounsbury, Richard E. 1397

1321 **Fisher, D. Jerome.** Natrophilite: Am. Mineralogist, v. 50, nos. 7–8, p. 1096–1097, table, 1965.

Natrophilite from the Branchville, Conn., pegmatite was examined by precession methods. The space group is either $Pna2_1$ or, more probably, *Pnam*; the unit cell has *a* 10.53, *b* 5.00, *c* 6.29 A. When heated to 985°C, the mineral was found to invert to a new form between 560 and 570°C. X-ray powder data for the new form, high natrophilite, are given. Similar heating of lithiophilite and triphylite produced no major changes in the powder diffraction paterns.—J.R.C.

1059 **Fisher, Frederick S.** Genesis of recent gypsum in the Stinkingwater Mining Region, Park Co., Wyoming: Wyoming Univ. Contr. Geology, v. 4, no. 2, p. 45–49, illus., 1965.

Bedded gypsum deposits, irregularly shaped and covering about one-quarter sq mi, occur in an intrusive complex in the Absaroka Mountains. Beds lie flat and range in thickness from a few to about 15 feet. The gypsum is a grayish white to buff yellow, massive, poorly indurated rock in hand specimen, but chemical analyses show it to be 93.3 percent pure with X-ray analyses indicating only Sr and small amounts of Fe. A possible origin is deposition in a small pond or lake formed by local disruption of drainage by landslides from Crater Mountain. Pond waters may have been enriched with calcium sulfate from surface water or hydrothermal leaching of mineralized and altered zones, by upward percolating ground water or enriched hydrothermal solutions, or by primary hydrothermal solutions.—M.C.

1375 **Fiskell, John G. A.; Carlisle, Victor W.** Differential thermal analysis of some clays and Florida soil clays: Soil and Crop Sci. Soc. Florida Proc. 1964, v. 24, p. 114–124, illus., table, 1965.

DTA studies of clay fractions in soils were made in Gadsden County on the Ruston, Norfolk, Red Bay, and Tifton loamy fine sands and the Faceville fine sandy loam, in Washington County on the Lynchburg and Portsmouth fine sands, and in Nassau County on the Leon and Blanton fine sands and the Weston loamy fine sand, and compared with standard samples of clay minerals or mineral mixtures to assess the amorphous gibbsite and halloysite–kaolinite content. Clays from profiles previously examined by X-ray diffraction gave characteristic patterns for allophane, gibbsite, and the kaolinite–halloysite. The peak shape of the 1:1 layer lattice endotherm indicated weathering in the upper horizons.—M.C.

1159 **Flatté, Stanley M.** Effects of changes in the Earth's rotation rate on sea level: Jour. Geophys. Research, v. 70, no. 20, p. 5189–5191, table, 1965.

The decrease in the Earth's angular velocity over the last 100 million years has had an effect on sea level. Comparison of the ellipticity of the Earth, as calculated from artificial satellite observations, and the ellipticity of a hydrostatic model gives

upper limits on the changes in sea level. These limits are 60 meters at the poles and −30 meters at the equator.—Author's abstract

1078 **Flint, Richard Foster.** The surficial geology of the New Haven and Woodmont quadrangles, with map: Connecticut Geol. and Nat. History Survey Quad. Rept. 18, 42 p., illus., tables, geol. map, 1965.

The bedrock geology of the quadrangles is discussed briefly. The glacial features are believed to have resulted from two successive glaciations, one moving south and the other southwest. Till and erratic boulders are described at some length. Much of the drift is in the New Haven and Farm River valley trains, the New Haven Clay (deposited in a glacial lake), and the fragmentary Quinnipiac valley train. Postglacial sediments are discussed also and the 10 soils of the area are shown in tables.—E.S.L.

1103 **Foster, Donald I.** Trapping mechanisms of selected fields, Cherokee Ridge, Wyoming and Colorado [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1576, 1965.

1319 **Foster, P. K.** Discussion on "Tridymite–cristobalite relations and stable solid solutions" by D. M. Roy and R. Roy [1964]: Am. Mineralogist, v. 50, nos. 7–8, p. 1130–1131, 1965.

Changes in diffraction angles of tridymite may be caused by structural changes rather than by solid solution effect, as was assumed by Roy and Roy [ibid., v. 49, p. 952, 1964]. For this reason, it is necessary to examine the complete diffraction pattern in discussing the stability relations of tridymite. The meaning of the term "stability" also requires clarification.—E.Z.

1233 **Frink, C. R.** Characterization of aluminum interlayers in soil clays: Soil Sci. Soc. America Proc., v. 29, no. 4, p. 379–382, illus., table, 1965.

Nine different Connecticut soils were analyzed. Those containing abundant interlayers underwent the largest changes in cation-exchange capacity (CEC), contained the most citrate-soluble Al and lost the most weight. Even though the increase in CEC was well correlated with the Al extracted, it appears that Al interlayers exist as "atolls", and that not all citrate-soluble Al is contained in interlayer positions. No evidence for the presence of Fe interlayers was found. A weathering sequence of illite–vermiculite–chloritized vermiculite–gibbsite is proposed for these acid soils.—E.S.L.

**Fryxell, Roald.** *See* Steen, Virginia C. 1153

1185 **Galbreath, Edwin C.** A dire wolf skeleton and Powder Mill Creek cave, Missouri: Illinois Acad. Sci. Trans., v. 57, no. 4, p. 224–242, illus., tables, 1964.

The skeleton of *Canis (Aenocyon) dirus* was discovered in the cave in 1963. Radiocarbon dates of the bones tested were 13,170±600 yr B.P. Bone dimensions indicate that the limb and foot proportions were more similar to those of the present day and the large dire wolves than to smaller specimens found at Rancho La Brea and also assigned to this species. The main channel of the cave is in Eminence Dolomite (Ordovician) but other parts are also cut in the overlying Gunter Sandstone and the Van Buren and Esconade Dolomites.—M.C.

1012 **Gálvez Cruz, Luis.** Uso de trazadores radiactivos para determinar el acarreo de sedimentos en la Bahía de Topolobampo [abs.], *in* Cong. Latinoamericano Química, 9th, San Juan, Puerto Rico, 1965, Resumenes Trabajos: Río Piedras, Puerto Rico, Colegio de Químicos, p. 35, 1965.

1230 **Garcia Rojas, A.** El teorema de la superposición y el filtrado en el dominio del tiempo: Asoc. Mexicana Geofísicos Explor. Bol., v. 6, no. 2, p. 113–139, illus., table, 1965.

Fundamental aspects of the theorem of superposition are presented and the equivalence of filtering in the realm of frequency and of time is demonstrated.

In the case of seismic records, filtering in the realm of time can be developed in analog or digital calculators. For developing filtering operations in digital calculators, it is necessary to have a large capacity for storage of data, and it is convenient to have a large velocity.—Author's abstract, V.S.N.

**Gardett, Peter H.** *See* Kistler, Philip S. 1281

1094 **Gatewood, L. E.** Criner–Payne area—Study in structural growth [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1563, 1965.

1212 **Gaucher, Edwin H. S.** Quantitative interpretation of the "Montagne du Sorcier" magnetic anomaly, Chibougamau, Quebec: Geophysics, v. 30, no. 5, p. 762–782, illus., 1965.

A ground magnetic survey of a portion of the Montagne du Sorcier showed an off-scale positive anomaly (>12,000 $\gamma$) over a magnetite-bearing serpentinite and an 11,000-$\gamma$ negative anomaly immediately south of it. Measurement of the magnetic properties of specimens from 73 oriented cores from the serpentinite indicate that the direction of remanent magnetization is that of the present Earth's field and therefore in the same direction as the induced magnetization. This suggests that the unusual shape of the anomaly can be explained by the topography of the mountain. The alinement of the remanent magnetization with the present Earth's field may be due to viscous realinement of the remanent magnetization. The sill is a possible source of iron ore.—D.B.V.

1209 **Gentile, Richard J.** Mineral commodities of Putnam County: Missouri Div. Geol. Survey and Water Resources Rept. Inv. 29, 48 p., illus., tables, 1965.

Large reserves of coal are present in Pennsylvanian strata which underlie the entire county, although all current mining activity is limited to the eastern part where the Lexington bed is mined. Ground water from glacial drift and a few formations in Ordovician, Devonian, and Mississippian rocks is the second most valuable commodity even though much of it is highly mineralized. Other commodities present in the area but considered only of minor economic importance are limestone, conglomerate, sand, gravel, oil, gas, shale, clay, and glacial drift. Some oil and gas test wells were drilled and showings were reported but no production has taken place.—M.C.

1178 **Geomap Company of Dallas.** Jurassic drilling in Mississippi and western Alabama, contoured on top of the Smackover: Geomap Co. Dallas Map 307, scale about 1 in to 6 mi, 1964.

The area covered by the map is the southern half of Mississippi and the northwest corner of Alabama. Because variable stratigraphy of the Jurassic makes correlation of stratigraphic equivalents difficult, users of the map should accept the top of the Smackover points as guides to regional structure only until future drilling clarifies the situation. Shown on the map are oil and gas fields, salt domes, Jurassic fields and Jurassic tests. Contour interval is 500 feet.—M.C.M.

1074 **Gerhard, Lee C.** Paleozoic paleogeology of the Canon City Embayment, Colorado [abs.]: Dissert. Abs., v. 26, no. 1, p. 312, 1965.

1079 **Gershanovich, D. Ye.** Osnovnyye rezul'taty morskikh geologicheskikh issledovaniy v Beringovom more i zalive Alyaska [with English abstract]: Mezhduvedomstv. Geofiz. Kom. USSR, Rezul'taty Issled. po Programme Mezhdunarod. Geofiz. Goda, Razdel 10, Okeanologicheskiye Issledovaniya, no. 13, p. 189–198, 1965.

Results of marine geologic surveys during and since the IGY in the Bering Sea and Gulf of Alaska are discussed. Epicontinental and geosynclinal areas can be distinguished by differences in their geomorphology and contemporary deposits.—D.B.V.

**Ghose, Subrata.** *See* Viswanathan, K. 1403

1424 **Giese, R. F., Jr.; Kerr, P. F.** The crystal structures of ordered and disordered cobaltite: Am. Mineralogist, v. 50, nos. 7–8, p. 1002–1014, illus., tables, 1965.

Single crystal X-ray studies indicate that the mineral cobaltite (COAsS) is orthorhombic with the arsenic and sulfur partially disordered. Heating in vacuum to 850°C completely disorders the arsenic and sulfur. The space group of this form is $Pa3$ and the structure is that of pyrite. Annealing in vacuum from 450°C orders the arsenic and sulphur completely. The space group is $Pca2_1$ (pseudoisometric). Examination of the related mineral gersdorffite (NiAsS) shows that it belongs to space group $P2_13$ and has an ullmanite (NiSbS) structure.—Authors' abstract

1314 **Gill, H. E.; Vecchioli, J.; Bonini, W. E.** Tracing the continuity of Pleistocene aquifers in northern New Jersey by seismic methods: Ground Water, v. 3, no. 4, p. 33–35, illus., 1965.

Seismic refraction measurements were used to draw a new bedrock contour map in Morris County, N. J., where the major ground-water supplies are found in Quaternary sand and gravel deposits filling pre-Pleistocene channels. Aquifer performance tests aided in tracing the continuity of the Quaternary aquifers in these channels. In one case, the lack of continuity between two wells substantiated the seismic prediction that two separate channels were involved. The success of the seismic exploration emphasizes the value of using such methods, so that test drilling can be devoted to exploring the more favorable areas for production wells. Authors' abstract

**Glover, Lynn.** *See* Briggs, R. P. 1009

1034 **Goldstein, Norman Edward.** The separation of induced from remanent magnetism of near-surface rocks by means of *in situ* measurements [abs.]: Dissert. Abs., v. 26, no. 2, p. 983–984, 1965.

1030 **Golomb, Berl.** Paleogeography of the Basin of Mexico [abs.]: Dissert. Abs., v. 26, no. 2, p. 979, 1965.

**Gordon, Ellis D.** *See* McGreevy, Laurence J. 1146

1312 **Grant, F. S.; Gross, W. H.; Chinnery, M. A.** The shape and thickness of an Archaean greenstone belt by gravity methods: Canadian Jour. Earth Sci., v. 2, no. 5, p. 418–424, illus., 1965.

The Red Lake greenstone belt in Ontario is a part of the Superior province of the Precambrian Shield and is older than 2.5 b.y. It is typically composed of a complex assemblage of lavas, sediments, and intrusives completely surrounded by granitic batholiths and acid paragneiss, thus being isolated from the other belts. Because of the greater density of the greenstones compared to surrounding granites, greenstones give positive gravity effects, with amplitudes indicating shape and overall thickness. Results of a gravity survey in 1962 seem to indicate that the Red Lake greenstone belt has a thickness not likely to exceed 27,000 feet and is an asymmetrical basin, resting on a granitic crust, with its axis displaced 3 mi to the south of the center of the belt.—M.C.

**Grant, F. S.** *See* Elsaharty, A. F. 1406

**Grantham, Rodney G.** *See* Musgrove, Rufus H. 1077

1035 **Gray, Robert Stephen.** Late Cenozoic sediments in the San Pedro Valley near St. David, Arizona [abs.]: Dissert. Abs., v. 26, no. 2, p. 984, 1965.

1339 **Green, L. H.** The mineral industry of Yukon Territory and southwestern District of Mackenzie, 1964: Canada Geol. Survey Paper 65-19, 94 p., tables, 1965.

Mineral production from the Yukon in 1964 included gold, silver, lead, zinc, cadmium, and coal, with the gold coming from placers in the Dawson, Mayo, and Whitehorse mining districts. The only lode producer was the United Keno Hill Mines Ltd. In the Nahanni mining district of Mackenzie the Canada Tungsten

Mining Corporation Ltd. reopened its tungsten property in the Flat River area, mined well over 59,000 tons from the open-cut from June-September, and had milled over 33,000 tons by the end of the year. Exploration of a bedded copper deposit near Little Dal Lake was continued. General descriptions of the history and geology of the major mining areas in the various districts of the Yukon and of Nahanni mining district, Northwest Territories, are included.—M.C.

**Greene, Robert C.** *See* Weir, Gordon W. 1382

**Greene, Robert C.** *See* Weir, Gordon W. 1441

**Griffin, Margaret S.** *See* Weld, Betsy A. 1139

1112 **Griffith, Earl G.** Geology of Saber Bar, Logan and Weld Counties, Colorado [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1575, 1965.

**Groh, E. A.** *See* Peterson, N. V. 1151

1408 **Groh, E. A.** Devils Hill–Broken Top area and Lava Butte area field trip—Geologic summary, *in* State of Oregon Lunar Geol. Field Conf. 1965, Guidebook: Oregon Dept. Geology and Mineral Industries Bull. 57, p. 1–10, illus., geol. maps, 1965.

Westward from Bend, Quaternary lava flows poured from vents on the eastern flank of the Cascade Range, some from fissures but most from vents now marked by cinder cones to the south. These lavas are a late manifestation of the same process that built the High Cascade Range beginning in Pliocene time. Great basaltic and basaltic andesite shields, with parasitic cones, make up the bulk of the High Cascades, lying on predominantly volcanic pre-Pliocene basement. Pyroclastic material, with andesite and dacite flows, then formed the peaks or stratovolcanoes. Fresh flows and cinder cones, unglaciated, indicate very recent volcanic activity, features of which are briefly described and illustrated.—G.D.C.

1297 **Gross, Eugene B.** A unique occurrence of uranium minerals, Marshall Pass, Saguache County, Colorado: Am. Mineralogist, v. 50, nos. 7–8, p. 909–923, illus., tables, 1965.

Schist adjacent to a fault zone has been replaced by uranium and sulfide minerals. The ore is in tabular or rounded masses with a yellow oxidized coating and a black interior of pitchblende and sulfides. Radioactive minerals include pitchblende, schoepite, ianthinite, epi-ianthinite, becquerelite, soddyite, boltwoodite, uranophane, zeunerite, metazeunerite, and autunite. Analyses are given of ore, schist, and soil.—M.L.L.

**Gross, W. H.** *See* Grant, F. S. 1312

1334 **Gross, W. H.; Ferguson, S. A.** The anatomy of an Archean greenstone belt: Canadian Mining and Metall. Bull., v. 58, no. 641, p. 940–946, illus., 1965.

The Red Lake greenstone belt is an irregular mass of lavas, sedimentary rocks and intrusives. Basaltic volcanics, the oldest rocks within the belt, were laid down on an ancient crust which is at least 3 b.y. old and was composed partly of sediments. The basalts are overlain by acid volcanics and sedimentary rocks which have been complexly folded. Emplacement of the intrusives and the accompanying regional metamorphism are believed to have occurred approximately 2.4 b.y. ago. Barren iron sulphide deposits of "strata-bound" type occur in the basaltic and acid volcanics and sedimentary rocks. Economic base-metal sulphides of this type occur only around the edges of the Archean craton; possibly "metallization" of barren Archean sulphides took place during later periods of orogeny.—from authors' abstract

**Grover, Donald G.** *See* Hunt, Lee M. 1385

**Gude, Arthur J., 3d.** *See* Sheppard, Richard A. 1145

1239 **Guthrie, R. D.** Variability in characters undergoing rapid evolution, an analysis of *Microtus* molars: Evolution, v. 19, no. 2, p. 214–233, illus., 1965.

A study is outlined of the intrapopulational variability present in the dentition of two species of *Microtus*, the fossil form of which is considered ancestral to the modern meadow vole. Quantitative characters undergoing rapid evolution do not show the decline in phenotypic variation predicted by present evolutionary concepts but, on the contrary, the variation is maintained and usually increased. The fossil form is the extinct *Microtus paroperarius* from the Kansas glacial deposits. In the molar crowns of both Recent and fossil species, the areas which are changing phylogenetically are those which vary most within the population. Evidence from other sources in which characters are undergoing directional selection, both evolutionary and artificial, suggests that a greater variation in characters undergoing directional selection is a general condition.—M.C.

1183 **Guy, H. P.** Residential construction and sedimentation at Kensington, Md., *in* Federal Inter-Agency Sedimentation Conf., Jackson, Miss., 1963, Proc., Symposium 1—Land erosion and control: U.S. Dept. Agriculture Misc. Pub. 970, p. 30–37, illus., tables, 1965.

Sediment transported in storm runoff during urbanization of part of an area was measured for 25 storm events in two and a half years. Total sediment discharge was 189 tons per acre for the entire period of construction and the subsequent return to reasonable stability. The high yield from the Kensington area is attributed to rolling topography, very friable soil and subsoil, construction of a street in the major drainage channel, exposure of extensive areas for a long time, and annual rainfall of 42 inches at a rate in excess of the infiltration capacity of unprotected soil.—G.D.C.

**Haas, J. L., Jr.** *See* Wyllie, P. J. 1161

1234 **Hammes, Richard R.** Ouachita overthrusting—Stratigraphic appraisal: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1666–1679, illus., 1965.

Lithology, thickness, and lithofacies of the Late Mississippian Wesley Formation of the Jackfork Group indicate sedimentation within a narrow transition zone along the northwest slope of the Ouachita trough. The formation thins northwestward, and sandstone beds included within it converge and intertongue with spiculite. Restoral of position of measured sections to fit within a uniform rate of convergence suggests total displacement by the Ouachita overthrusting of only 20–30 miles. E.K.M.

**Hardaway, J. E.** *See* Mifflin, M. D. 1140

1111 **Harms, J. C.** Stratigraphic traps in a valley fill, western Nebraska [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1575, 1965.

1235 **Harrington, Horacio J.** Space, things, time, and events—An essay on stratigraphy: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1601–1646, illus., 1965.

This paper is an attempt to analyze the meaning of the basic concepts of stratigraphy, space, locality, material things, time, events, simultaneity, succession, correlation, geological time-table, geological key-events, relationship between stratigraphy and paleontology, zones, stages, "time-rock units", and "time-units". Physical stratigraphy is a science that deals with the spatial relationship of material things; historical stratigraphy deals with the spatial and temporal relationships of events.—W.C.C.

1047 **Harris, Arthur Horne.** The origin of the grassland amphibian, reptilian, and mammalian faunas of the San Juan-Chaco River drainage [abs.]: Dissert. Abs., v. 26, no. 2, p. 1228, 1965.

1168 **Harris, H. B.** Ground-water resources of La Salle and McMullen Counties, Texas: Texas Water Comm. Bull. 6520, 96 p., illus., tables, 1965.

Major aquifers in this Coastal Plain area are three beds in the Claiborne Group of Eocene age, of which Carrizo Sand is most important. Minor amounts of water are supplied by other formations and the surface deposits. Water quality ranges from fresh to saline and much of it is not suitable for irrigation though it serves other needs of the area. Estimates of water available from the Carrizo Sand at 90,000 acre-feet per year probably do not give a true picture, for withdrawal in areas to the northwest exceeds recharge now and may result in lowering the quality of all the water in the formation.—M.C.

1123 **Harris, Steven H.** Relation of Mission Canyon stratigraphy to oil production in north-central North Dakota [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1571, 1965.

**Harris, Wiley F., Jr.** *See* Dodson, Chester L. 1251

**Hart, S. R.** *See* Rama, S. N. 1365

1267 **Harvey, E. J.; Callahan, J. A.; Wasson, B. E.** Ground-water resources of Hinds, Madison, and Rankin Counties, Mississippi: Mississippi Board Water Commissioners Bull. 64-1, 38 p., illus., tables, 1964.

The Jackson metropolitan area, which includes the above three counties, has abundant reserves of ground water of good quality. The water occurs at depths greater than 2,000 feet almost everywhere in the area and the major potential and present sources are the Wilcox Group, Sparta Sand, Cockfield Formation, Forest Hill Sand, and Catahoula Sandstone, all of Tertiary age, with small supplies of hard water in surficial deposits. Sparta Sand is the principal aquifer from the standpoint of total pumpage with wells yielding from 200 to 1,000 gpm and a pumpage of 10 mgd. Probably about 5 mgd can be withdrawn from ground water sources in the area without seriously lowering the water table below feasible pumping depths.—M.C.

1316 **Hathaway, John C.; Sachs, Peter L.** Sepiolite and clinoptilolite from the Mid-Atlantic Ridge: Am. Mineralogist, v. 50, nos. 7-8, p. 852-867, illus., tables, 1965.

Sepiolite has been found in samples dredged from the Mid-Atlantic Ridge. The mineral is intimately associated with laminated clay and coccolith ooze, both containing clinoptilolite; one sample contained chert. Serpentine was recovered in the same dredge, but the sepiolite seems to have formed by the reaction of Mg in solution with $SiO_2$ liberated during alteration of silicic volcanic ash, rather than by direct alteration of the serpentine.—Authors' abstract

1327 **Hathaway, John C.; Schlanger, Seymour O.** Norstrandite ($Al_2O_3 \cdot 3H_2O$) from Guam: Am. Mineralogist, v. 50, nos. 7-8, p. 1029-1037, illus., tables, 1965.

Norstrandite occurs in radiating bladed aggregates in secondary solution cavities in limestone. Biaxial +, $\alpha = 1.580$, $\beta = 1.580$, $\gamma = 1.596$. X-ray powder diffraction data include reflections with d = 4.789A, 4.322, 4.207, and 2.263. Analyses data are given.—M.L.L.

1062 **Hatt, Robert T.** The littlest mastodon: Cranbrook Inst. Sci. News Letter, v. 35, no. 2, p. 20-23, illus., 1965.

The jaw of a baby mastodon, whose third and fourth premolars are in place, one showing just a trace of use and the other in position to erupt from the gum, recently has been added to the Cranbrook collections. Most interesting is the presence of a small incisor, a tusk 2 inches long with three cusps, which still has an enamel cap. This baby was found not far from the site of an adult find, on the fringe of Pontiac, Michigan.—G.D.C.

1167 **Haught, Oscar L.** Oil and gas report on Braxton and Clay Counties, West Virginia: West Virginia Geol. and Econ. Survey Bull. 29, 19 p., illus., tables, 1964.

Broken exposures of Pennsylvanian rocks in these two counties occur on a regional monocline dipping gently northwest upon which is superimposed a series of gentle

folds striking northeast. Faulting is not present at the surface but deep well records indicate a probable break in the Oriskany Sandstone with a vertical displacement of almost 200 feet, absorbed in the overlying thick Devonian section. The stratigraphic nomenclature and producing sands of Silurian to Permian(?) age, drilling development since 1935, and prospects for the future in the various districts are summarized.—G.D.C.

**Haun, John D.** *See* Barlow, James A. 1109

1186 **Hawaii Div. Water and Land Devel.** Summary of drilling log and pumping test for Pulama Well 9-10, Pulama, Puna, Hawaii: Hawaii Div. Water and Land Devel. Circ. C26, 12 p., illus., tables, 1964.

This well, four miles west of Kalapana Black Sand Beach, lies 1.8 miles inland from the coast at an elevation of 230 feet, its depth extending 20 feet below sea level. The rocks penetrated are highly permeable basalt flows of the Puna volcanic series which erupted from a rift zone four miles away. The aquifer rocks are cinders and clinkers reported at depths between 233 and 250 feet. Several faults roughly parallel to the east-west trending rift zone have been mapped, but it is not known what effect, if any, the structural geology has on the aquifer system. Although annual rainfall of 75 to 100 inches in the area should maintain a fresh water lens, the well is subject to changes in chlorides under pumping conditions.—G.D.C.

1442 **Hayes, Philip T.; Landis, Edwin R.** Paleozoic stratigraphy of the southern part of the Mule Mountains, Arizona: U.S. Geol. Survey Bull. 1201-F, p. F1-F43, illus., 1965.

Type sections of Cambrian, Devonian, and Mississippian rock units that are now widely recognized in southeastern Arizona are re-examined and described in detail for the first time. Principal reference sections for the Pennsylvanian and Permian formations are described also.—W.L.G.

**Hedge, C. E.** *See* Tatsumoto, M. 1258

1188 **Heezen, Bruce C.; Hollister, Charles.** Deep-sea current evidence from abyssal sediments: Marine Geology, v. 1, no. 2, p. 141-174, illus., table, 1964.

Relatively strong bottom currents in the deep sea are inferred from sedimentary structures observed in bottom photographs and cores. High, steep features such as seamounts, escarpments, and crests of major ridges show ripples, scour, and rock outcrops. Photographic evidence of currents is relatively rare on the ocean basin floor, but scour and ripples are observed beneath the Antarctic botom current in the western South Atlantic, beneath the Gulf Stream in the Florida Straits, and elsewhere. The three types of deep-sea sands and silts are accretionary and residual, always associated with bottom currents, and turbidites, reworked by them in some areas. Traction velocities necessary for transport of particles probably range from 4 to 60 cm per sec.—V.M.J.

1293 **Herrera, Ismael.** A perturbation method for elastic wave propagation—[Pt.] 3, Thin inhomogeneities [with Spanish abs. and text]: Geofísica Internac., v. 5, no. 1, p. 1-14, illus., 1965.

A first order theory is developed to treat the scattering of elastic waves by small inhomogeneities. Attention is restricted to inhomogeneities for which the perturbation of the elastic properties is not small but the perturbed region is thin. Geological formations satisfying these conditions are dykes, lenses, etc. Using the integral representation theorems of elastodynamics, the solutions are expressed as integrals of known quantities.—Author's abstract

**Hershey, Robert E.** *See* Luther, Edward T. 1050

**Hershey, Robert E.** *See* Luther, Edward T. 1051

1016 **Hirekerur, Laxmikant Rangrao.** Clay mineralogy and release and fixation of potassium in some soil series of Minnesota [abs.]: Dissert. Abs., v. 26, no. 2, p. 581, 1965.

**Hirooka, Kimio.** *See* Dalrymple, G. Brent. 1422

1448 **Hochstein, Manfred.** Überlegungen zur Erfassung der Tagesvariationen bei magnetischen Messungen in Mittelgrönland [with English abs.]: Polarforschung, v. 34, no. 5, pts. 1–2, p. 281–285, illus., table, 1965.

In high latitudes the reduction of daily magnetic variations and disturbances is possible with records of a remote observatory, if field station and observatory are located on nearly the same magnetic latitude ($\Delta\Phi \leq 1.5°$) and if the field measurements are done during "quiet intervals;" the deviation of the smoothed Z component should not exceed $\pm 20\ \gamma/10$ min.—Author's English abstract

**Hodgson, J. H.** *See* Langill, F. E. 1066

1302 **Hoffer, Abraham.** Seismic control of layering in intrusions: Am. Mineralogist, v. 50, nos. 7–8, p. 1125–1128, 1965.

The author argues against a single-cell mechanism for layering in sheet-like intrusions on the basis that convection cells are likely to have lateral dimensions equal to the thickness of the sheet, by analogy with convection cells at the Sun's surface. It is proposed instead that seismic shock may cause layering by intermittent agitation of a supersaturated magma to modify rates of crystal nucleation, growth and settling. Number of layers should approximately equal the number of earthquakes and thickness of individual layers should be related to the interval between earthquakes. Comparison with seismic records is suggested to evaluate the mechanism.—B.C.H.

1358 **Holcomb, C. W.; Pickering, J. W.** Frio cross section, A–A′: Corpus Christi, Tex., Corpus Christi Geol. Soc., 1964.

1329 **Holdaway, M. J.** Basic regional metamorphic rocks in part of the Klamath Mountains, northern California: Am. Mineralogist, v. 50, nos. 7–8, p. 953–977, illus., tables, 1965.

The Stuart Fork greenstone (I), Salmon Hornblende Schist (II), Grouse Ridge Hornblende Schist (III), (from bottom to top) can be mutually distinguished by texture and by mineralogy. Plagioclase is albite in I, albite–oligoclase in II, and is still more calcic in III. The peristerite gap is bridged by a single plagioclase, although some of the crystals may be peristeritic. Epidote shows a composition gap in I but none in II or III; a miscibility gap may exist between $Fe^3$ rich and $Fe^3$ poor epidote at low temperature. Amphibole is actinolite (some blue amphibole) in I, hornblende in II, and low $Fe^3$ hornblende in III. The differences in mineralogy are explicable in part by bulk composition. The rocks have undergone two episodes of metamorphism and their superposition may be partly tectonic.—E.Z.

1359 **Holden, R. N.; Treadwell, R. C.** Frio cross section, B–B′: Corpus Christi, Tex., Corpus Christi Geol. Soc., 1964.

1135 **Hollin, John T.** Wilson's theory of ice ages: Nature, v. 208, no. 5005, p. 12–16, illus., 1965.

Evidence for and against the rapid but temporary rise of sea level, of 30–100 feet, that should occur just before each ice age if A. T. Wilson's (1964) hypothesis is valid, is examined. "Surges" of present ice caps and Quaternary sea levels are discussed. The weight of the evidence to date seems favorable to Wilson's explanation.—D.B.V.

**Hollister, Charles.** *See* Heezen, Bruce C. 1188

1091 **Holmes, K. H.** Stratigraphic traps in northwest Quinlan and Cedardale fields, northwestern Oklahoma [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1563, 1965.

**Hoover, L. R.** *See* Prickett, T. A. 1383

1354 **Hopf, Robert W.** The Poth sand trend of southwest Texas, Pt. 1: South Texas Geol. Soc. Bull., v. 5, no. 13, p. 5–10, illus., tables, 1965.

The Poth sand fields of Wilson and Gonzales Counties are located on the southwest flank of the San Marcos Arch. Numerous up-to-the-coast normal strike faults traverse the area, part of the Darst Creek–Mexia system of relief faults which are the trapping mechanism for oil accumulation in the Eocene and Upper Cretaceous sands and limestones. The producing sands are listed and the Poth sands, occurring in the upper Midway Group in the Wills Point Formation, are described briefly. The history of development of the fields is summarized, along with reservoir characteristics. Subsurface exploration has disclosed hitherto unknown faults, and the possible extension of the trend for some 300 miles on strike and 35 miles on dip.—G.D.C.

**Horn, M. E.** *See* Rutledge, E. M. 1005

1006 **Horn, M. E.; Rutledge, E. M.** The Dickson and Zanesville soils of Washington County, Arkansas—[Pt.] 2, Micromorphology of their fragipans: Soil Sci. Soc. America Proc., v. 29, no. 4, p. 443–448, illus., 1965.

The micromorphological features were studied in thin sections and found to be very similar. Fragipans differ from overlying horizons in their greater content of optically oriented clay. Their properties and genesis appear to be related to the precipitation and concentration of iron oxides and clay on void walls and in the soil matrix near the voids as a result of diffusion of solutions within the soil matrix and movements of water in the void system. The silt in these soils can be accounted for through weathering of their underlying rocks.—E.S.L.

1144 **Horton, Robert C.** Temperature measurements, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF–1001, p. 184–192, illus., table, 1964 [1965].

Preshot measurements were made at selected stations in underground workings and drill holes to determine the thermal gradient and conductivity of a granite mass in situ, the Sand Springs Range. Temperatures in 2-ft drill holes in the shaft at six points from 410 to 1,251 feet ranged from 17.6°C to 19.9°C but are not considered as representing the thermal gradient. Temperatures in 15 holes, mostly 2 feet deep, ranged from 19.70–20.20°C on one day and, three days later, from 20.20–20.75°C in the East Drift. In core hole ECH–D temperatures were measured at 15 100-ft ranges for depths from 50 to 1,450 feet just one day after drilling was completed and again 7.5 months later. Temperature gradients scaled from the later log show increases from 0.44 to 0.83°C.—M.C.

1380 **Hose, Richard K.** Geologic map and sections of the Conger Range SE quadrangle and adjacent area, Confusion Range, Millard County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I–435, scale 1:24,000, 1965.

1381 **Hose, Richard K.** Geologic map and sections of the Conger Range NE quadrangle and adjacent area, Confusion Range, Millard County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I–436, scale 1:24,000, 1965.

1098 **Howell, Orvie.** O.S.A. and Gillian pools, Sedgwick County, Kansas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1561–1562, 1965.

**Howie, R.** *See* Milne, J. 1201

**Huber, N. King.** *See* Rinehart, C. Dean. 1254

1036 **Hudson, Robert Frank.** Structural geology of the Piney Creek thrust area, east flank Bighorn Mountains, Wyoming [abs.]: Dissert. Abs., v. 26, no. 2, p. 984–985, 1965.

1150 **Huff, L. C.; Lesure, F. G.** Geology and uranium deposits of Montezuma Canyon area, San Juan County, Utah: U.S. Geol. Survey Bull. 1190, 102 p., illus., tables, geol. maps, 1965.

The Montezuma Canyon area of San Juan County, Utah, includes the flat uplands near Monticello and the deep canyon system of Montezuma Creek and its tributaries. Geological formations exposed in this area range from the Navajo Sandstone of Triassic(?) and Jurassic age to the Mancos Shale of Late Cretaceous age. In all, about 1,500 feet of sedimentary strata is exposed. Massive sandstone beds within the Salt Wash Member of the Morrison Formation of Late Jurassic age contain many scattered uranium-vanadium deposits. However, only a few mines have produced more than 1,000 tons of ore. The occurrence, structures, geochemistry and origin of the ores are discussed in detail.—W.L.G.

1323 **Huggins, Charles W.; Shell, H. R.** Density of bulk chrysotile and massive serpentine: Am. Mineralogist, v. 50, nos. 7–8, p. 1058–1067, illus., tables, 1965.

Measurements on 23 bulk specimens of chrysotile and seven massive serpentine samples give densities 2.19 to 2.25 gm/cc (Arizona chrysotile), 2.40 to 2.44 (Arizona massive serpentine blocks) and 2.34 to 2.39 (Canadian chrysotile). The bulk density measurements approximate the densities calculated assuming partial void volumes based on hollow tubes and are less than that postulated from X-ray diffraction data for a solid structure. Analyses are given.—M.L.L.

1385 **Hunt, Lee M.; Grover, Donald G.** (editors) A glossary of ocean science and undersea technology terms: Arlington, Va., Compass Publications, 172 p., illus., tables, 1965.

The glossary proper (p. 1–131) contains over 3,500 engineering and scientific terms used in the fields of oceanography, marine sciences, ocean engineering, underwater sound, and underwater physiology. An appendix (p. 133–170) includes tables of astronomical and physical constants, properties of sea water, elements in sea water, classification of marine environments, survey of oceanographic instrumentation, summary of the characteristics of surface navigation systems, and the like. A list of references concludes the glossary.—M.C.

1004 **Hutcheson, T. B., Jr.; Bailey, H. H.** Effect of underlying residua on chemical and mineralogical properties of soils developed in a uniform loess overlay: Soil Sci. Soc. America Proc., v. 29, no. 4, p. 427–432, illus., tables, 1965.

Chemical and mineralogical studies support the concept that the Lexington, Wellston, Bewleyville, and Dewey soil series, western Kentucky, were developed in widely different residua overlain by a rather uniform loess mantle. Greater weathering of the loess mantle occurred, accompanied by illuviation of materials into the residuum, when underlain by coarser textured residual material.—Authors' abstract

1394 **Hutchinson, R. W.** Genesis of Canadian massive sulphides reconsidered by comparison to Cyprus deposits: Canadian Mining and Metall. Bull., v. 58, no. 641, p. 972–986, illus., tables, 1965.

The copper-zinc massive sulphide deposits of the Keewatin greenstone belts in the Canadian Precambrian have long been considered epigenetic, hydrothermal replacement deposits. Similar deposits are present in Cyprus, and a comparison of these with the Canadian ores suggests a very different mode of origin. Evidence suggests that the Cyprus deposits are syngenetic, volcanic-exhalative bodies formed during the closing extrusive phases of the volcanism that formed a major igneous complex. The Canadian deposits are believed to have formed originally in the same manner, but have undergone an additional, complex, genetic history related to subsequent orogenic deformation of the Keewatin belts. The purpose of this paper is to present the data and the comparisons supporting this genetic concept and

thereby to re-open the question of origin of these important Canadian ores. Author's introduction

1262 **Hutchison, Harold C.** Distribution, structure, and mined areas of coals in Dubois County, Indiana: Indiana Geol. Survey Prelim. Coal Map 10, scale about 1 in. to 2 mi., 1964.

In addition to the principal map, the sheet includes a map showing coal reserves of the county and contours on the bedrock surface in the northwestern part, a lithologic section, and cross sections showing land surface and position of principal coal beds.—M.C.M.

1211 **Hutchison, W. W.; Baer, A. J.; Souther, J. G.** Geology, Prince Rupert–Skeena, British Columbia: Canada Geol. Survey Prelim. Ser. Map 3–1965, scale 1:253,440, text, 1965.

Correlation of rocks in the Prince Rupert–Skeena area is difficult due to basic lithologic differences in the major outcrops of the metasediments and to complex folding and metamorphism. Glacial striae and large erratics indicate that the last major ice movement has been from the northeast towards the southwest. The structure of the area is complex, with some evidence that the direction of tectonic transport has been towards the southwest. On Porcher Island gold and copper prospects have been known for many years, and magnetite occurs in an iron formation close to its eastern shore.—M.C.M.

1376 **Ichikawa, M.; Basham, P. W.** Variations in short-period records from Canadian seismograph stations: Canadian Jour. Earth Sci., v. 2, no. 5, p. 510–542, illus., tables, 1965.

Relative recording ability of some Canadian seismograph stations shows a pattern of *P*-wave amplitude anomalies varying from station to station and at any one station, showing a significant regional variation apparently not entirely produced by source mechanism effects. Local crustal effects appear important and spectral studies indicate that significant effects can be produced in low velocity upper crustal layers. The initial study of early *P*-wave trains and theoretical models suggests that these crustal effects can best be examined by use of apparent incident angles, and that spectral amplitude decrements change significantly from station to station. Different recording ability of stations probably can be explained by a combination of shallow crustal effects operating on the signal amplitude and local noise properties.—M.C.

**Jackson, M. L.** *See* Raman, K. V. 1300

1214 **Jahren, Charles E.** Magnetization of Keweenawan rocks near Duluth, Minnesota: Geophysics, v. 30, no. 5, p. 858–874, illus., 1965.

Remanent magnetization measurements on 200 oriented samples from Keweenawan gabbro, diabase, and associated rocks in the Duluth area show a clustering of directions west–northwestward and downward. Remanent magnetization is important in all the rocks studied. Q values range from 0.3 to 75, but are less than 1.0 in only 15 samples. Average volume magnetic susceptibility ranges from 0.3 to $6.0\times10^{-3}$ cgs. There is no apparent correlation between magnetic susceptibility and direction of remanent magnetization. A Keweenawan pole at lat 30°–34° N., long 175°–180° W. is indicated.—D.B.V.

**Jerome, S. E.** *See* Beal, Laurence H. 1008

1138 **Jerome, S. E.** Introduction, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF–1001, p. 11–14, illus., 1964 [1965].

Project Shoal underground nuclear explosion was proposed to gather data on characteristics of seismic waves generated by man-made explosions, especially for detection and identification of the nuclear type. The Sand Springs Range, Nevada,

a Cretaceous granitic fault block, best met the following Project Shoal basic requirements: granite or tuff in an area of simple geologic structure, no relief variations over 1,000 feet within 2 miles of site, possible emplacement depth of 1,500 feet in granite, location in currently active seismic area with recent history of shallow-focus earthquakes, granite outcrops within 1,500 feet of site center, and area low in population and several miles from man-made structures.—M.C.

1310 **Jillson, Willard Rouse.** Biangular faulting in the outer Bluegrass region of northern Kentucky: Frankfort, Ky., Roberts Printing Co., 26 p., illus., 1965.

A remarkable biangular fault block, known as the Drennon Fault Block, is located in northeastern Henry County, Ky., occupying about 8 sq mi across the lower valley of Drennon Creek, just west of the Kentucky River; the topography is typical semi-mature dissection of a plateau of low elevation. The rocks range from Middle Ordovician Cynthiana to Upper Ordovician Richmond limestones and shales; a brief list of index fossils is given. The structure is bounded on the northeast by a group of four parallel faults (bounding two grabens and a horst) with strike of N. 75° W., and on the southwest by two faults (bounding a graben) with strike of N. 58° W. Regional relationships with the Severn Valley Fault and the Hickman-Paris-Maysville Fault, and their bearing on uplift of the Jessamine Dome are discussed.—V.M.J.

1187 **Johnson, Hamilton M.** An automated approach to formation evaluation, *in* SPWLA Logging Symposium, 6th Ann., Dallas, Tex., 1965, Trans., V. 1: Houston, Tex., Soc. Prof. Well Log Analysts, p. 1-3, 1965.

Advances in solid-state physics to allow greater miniaturization of components, improvements in thermal insulation and heat tolerance within these components, and more "packaging" of stages in amplifying and recording units have provided downhole tools and field measurements which were impossible just a few years ago. These developments led to the real breakthrough that allows a "space-age" concept in formation evaluation; this is massive use of the digital computer. The computer makes possible a foot by foot (or even more frequent analysis, where meaningful) study of entire wells rather than just isolated, potentially productive, zones.—J.W.C.

1090 **Johnson, J. F.** Recent advances in geology and geophysics [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1563-1564, 1965.

1436 **Johnson, J. Harlan; Kaska, Harold V.** Fossil algae from Guatemala: Colorado School Mines Prof. Contr. 1, 152 p., illus., tables, 1965.

In the course of geological work of a number of American oil companies, in the extensive exploration program in Guatemala between 1956 and 1963, a nearly complete section of sedimentary rocks of Permian to Miocene age was encountered in various parts. Numerous limestones occur, many containing well preserved algae, from which thin sections were made and studied in the laboratory of the Guatemala subsidiary of the California Exploration Company. To prevent the loss of this collection of 25,000 slides when the exploration program collapsed, the authors received permission and approval to make the systematic study of the algae reported herein. Those slides used as type specimens and figured in the plates are deposited in the U.S. National Museum.—G.D.C.

**Jones, Gary E.** *See* Pearson, John E. 1206

1287 **Jones, H. J.** Algalogical investigations in Mammoth Cave, Kentucky [with German summary]: Internat. Jour. Speleology, v. 1, pt. 4, p. 491-516, illus., tables, 1965.

Algalogical investigations carried out in this cave revealed the presence of 27 taxa representing all divisions of Algae except Pyrrhophyta and Phaeophyta. Diatoms although observed in the samples were not dealt with in the present paper. Several rare and interesting algae were found including two new Cyanophyta. A comparison is made between the algal flora here and that found in several European caves. The ecology of the cavernicole algae is discussed.—G.D.C.

1126 **Jones, Llewelyn.** Sedimentation and economic prospects of Middle Devonian Winnipegosis Formation of Saskatchewan [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1570, 1965.

1231 **Jordan, James; Black, Rudolph; Bates, Charles C.** Patterns of maximum amplitudes of Pn and P waves over regional and continental areas: Seismol. Soc. America Bull., v. 55, no. 4, p. 693–720, illus., 1965.

Pn- and P-wave maximum amplitude patterns over the United States have been contoured on the basis of a number of well-recorded seismic events with unified magnitudes of 4 to 5, occurring both within and without North America. The seismogeological events reported by Pasechnik (1962) for Eurasia appear to be present, for there are marked and persistent deviations from the conventional curves of amplitude attenuation with distance. It is suggested that high signal anomalies are typical of areas of deep sedimentary basins or high upper mantle velocities, while low signal levels tend to be typical of areas with considerable tectonic activity and low upper-mantle velocities.—D.B.V.

1026 **Kalkanis, George.** Transportation of bed material due to wave action [abs.]: Dissert. Abs., v. 26, no. 2, p. 960, 1965.

1421 **Kalliokoski, J.** North American massive sulfide deposits—A correction [for 1965 paper]: Econ. Geology, v. 60, no. 7, p. 1539–1540, 1965.

This is an addendum to article by same author, "Metamorphic features in North America massive sulfide deposits", Econ. Geology, v. 60, no. 3, p. 485–505, 1965. Strata-bound pyritic Pb-Zn-Cu deposits favor Ordovician volcanic assemblages, though isotopic age of Pb is apparently Devonian. Deformation of sulfides formed contemporaneously may produce misleading apparent paragenesis.—W.S.W.

1067 **Kanasewich, E. R.; Farquhar, R. M.** Lead isotope ratios from the Cobalt–Noranda area, Canada: Canadian Jour. Earth Sci., v. 2, no. 4, p. 361–384, illus., tables, 1965.

Lead isotope ratios in very old galenas in Archean volcanics and sediments at Timmins, Ontario, and Val d'Or and Noranda, Quebec, indicate additions of young lead of the type found near Cobalt, Ontario. This mixing of lead of two ages produces linearly related isotopic ratios; the greatest degree of mixing occurs in this area at the Archean—Bruce–Cobalt rock boundary. Relationship of the anomalous lead line and the single stage growth curve indicates the occurrence of lead sulfide mineralization in the Archean rocks of Ontario and Quebec about 3,250±150 m.y. ago, thus showing that crustal rocks existed in North America prior to 3,200 m.y. ago.—M.C.

**Kaska, Harold V.** *See* Johnson, J. Harlan, 1436

1064 **Kauffman, Erle G.** Middle and Late Turonian oysters of the *Lopha lugubris* group: Smithsonian Misc. Colln., v. 148, no. 6 (Smithsonian Inst. Pub. 4602), 92 p., illus., tables, 1965.

The present investigation attempts to demonstrate the feasibility of detailed systematic and evolutionary study, faunal zonation, and regional correlation based on oysters. It employs simple biometric analysis of large collections, from numerous localities, distinct stratigraphic levels, and diverse sediment types. The *Lopha lugubris* lineage is the predominant ostreid species group in Upper Cretaceous of the Western Interior and western Gulf Coast. They are abundant in the Eagle Ford Shale of Texas, the Mancos Shale of New Mexico, and the Carlile Shale of Colorado, New Mexico, and rarely Kansas. Their structural complexity is greater than in many other ostreid types. Its immediate ancestor is unknown, but it appears to have had a Gulf Coast origin in the United States.—G.D.C.

1128 **Keating, Louis F.** Exploration in Canadian Rockies and foothills [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1567, 1965.

**Kerr, P. F.** *See* Giese, R. F., Jr. 1424

**Kiilsgaard, Thor H.** *See* Merrill, Charles W. 1190

1086 **King, C. R.** Alameda field—Sedgwick embayment "sleeper" [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1562, 1965.

**King, J. C.** *See* Laudise, R. A. 1061

1221 **Kissling, Don L.** Coral distribution on a shoal in Spanish Harbor, Florida Keys [with Spanish summ.]: Bull. Marine Sci., v. 15, no. 3, p. 599–615, illus., 1965.

Bottom characteristics and population densities of corals were determined for an area 25 by 45 feet on a current-swept shoal in Spanish Harbor. Water depths at low tide increase northward in the study area, whereas the abundance of *Thalassia testudinum* increases southward. Firm substrate decreases in percentage away from the center and is covered by fine sediment in the southernmost part, where dense vegetation impedes sediment-winnowing by the north-south tidal currents. Sediment in the northernmost part is coarser. Numerous mollusks and 1,400 coralla are found in the area, unattached colonies sharing the habitat with four attached species, which depend on firm substrate.—G.D.C.

1281 **Kistler, Philip S.; Gardett, Peter H.** Dwight Holbrook Thornburg (1895–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1539–1540, portrait, 1965.

1017 **Kline, Jerry Robert.** An investigation of copper and other selected elements in soils utilizing gamma radiations induced by thermal neutron activation [abs.]: Dissert. Abs., v. 26, no. 2, p. 582, 1965.

1295 **Knox, W. A.** Reply [to comments by R. E. Houtz and John I. Ewing on 1965 paper]: Jour. Geophys. Research, v. 70, no. 20, p. 5331, 1965.

Replying to Houtz and Ewing (ibid., p. 5330), Knox states that the comparison of his results with theirs was made because most of his profiles fell within the southern limits of Houtz and Ewing's area, and because the correspondence between their interval-time velocity functions and his average velocity function appeared too close to be accidental.—D.B.V.

**Koizumi, M.** *See* Kume, S. 1260

1320 **Komatsu, Hiroshi; Sunagawa, Ichiro.** Surface structures of sphalerite crystals: Am. Mineralogist, v. 50, nos. 7–8, p. 1046–1057, illus., 1965.

Surface structures of faces of sphalerite crystals from many localities were studied both by ordinary reflection microscope and by phase contrast microscope.—E.H.R.

1189 **Krammes, Jay S.** Seasonal debris movement from steep mountainside slopes in southern California, *in* Federal Inter-Agency Sedimentation Conf., Jackson, Miss., 1963, Proc., Symposium 1—Land erosion and control: U.S. Dept. Agriculture Misc. Pub. 970, p. 85–88, illus., tables, 1965.

The slopes of the San Gabriel Mountains, averaging more than 65 percent, maintain a precarious equilibrium. Dry-season debris creep, easily triggered, is an important part of their erosion. This paper reports a comparative study of dry- and wet-season debris movement in these unstable watersheds. The experimental sites were chosen in a single rock type, the Wilson Diorite, which underlies about a third of the San Gabriel Mountains. The soils are shallow, coarse-textured, noncohesive, and very erodible. The forces of wind, water, and gravity on the side slopes are variable and interdependent; gentle rains decrease the creep by increased cohesion of soils. The greatest debris source is from south-facing rejuvenated slopes. Storm floods carry the cumulative debris down the stream channels.—G.D.C.

1115 **Kranzler, Irvin.** Origin of lower Tyler oil in central Montana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1573, 1965.

1163 **Kremp, Gerhard O. W.** Morphologic encyclopedia of palynology—An international collection of definitions and illustrations of spores and pollen: Arizona Univ. Program Geochronology Contr. 100, 185 p., illus., 1965.

This encyclopedia is designed to serve as a standard text in questions concerning morphology of modern and fossil spores and pollen and as a source of information for understanding the descriptive literature in palynology. It contains citations of about 1,280 morphologic terms, 1,650 original definitions, 560 additional definition references, and 822 illustrations taken from 70 representative publications. Each entry is augmented with a list of terms of similar meaning with plural forms and etymology. All foreign terms and definitions have been translated into English. A complete bibliographic reference list is given. Although the term palynology, in some definitions, includes the study of flagellates, diatoms, hystrichospheres, and some protozoans, morphologic terms applied specifically to these organisms are not found herein.—V.M.J.

**Krivoy, Harold L.** *See* Moore, James G. 1076

1260 **Kume, S.; Koizumi, M.** Synthetic pollucites in the system $Cs_2O$-$Al_2O_3$-$4SiO_2$-$Cs_2O$-$Fe_2O_3$-$4SiO_2$-$H_2O$—Their phase relationship and physical properties: Am. Mineralogist, v. 50, nos. 5–6, p. 587–592, tables, 1965.

An X-ray and optical investigation has been made of synthetic zeolites in the system pollucite ($Cs_2Al_2Si_4O_{12}$·Aq)—the iron analog ($Cs_2Fe_2Si_4O_{12}$·Aq), crystallized at 450°C and 1,000 kg/cm$^2$ water vapor pressure. Refractive indices and lattice dimensions of these zeolites show a linear relationship with composition. From the results of the magnetic susceptibility measurements, the specimens seem to behave paramagnetically in the temperature range from liquid nitrogen to room temperature.—Authors' abstract

1285 **Kupsch, W. O.** Frederic Harrison Edmunds (1898–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1532–1533, portrait, 1965.

1311 **Lambert, A.; Caner, B.** Geomagnetic "depth-sounding" and the coast effect in western Canada: Canadian Jour. Earth Sci., v. 2, no. 5, p. 485–509, illus., table, 1965.

An east-west earth-current profile was made in 1964 in British Columbia to investigate the coast effect, which has been interpreted as resulting from two other different effects: the land-sea interface at periods of less than 10–15 minutes, and an associated upper mantle structure at periods of more than 30 minutes. The latter has been identified tentatively with the discontinuity of the seismic low-velocity layer under continental and oceanic regions. Inland anomalies of western North America have been interpreted on the basis of a moderately conducting zone at the top of the mantle, tentatively identified with the anomalous seismic low *P* velocity zone. If confirmed by further observations, these results imply temperature rather than density effects as the cause of the low *P* velocities.—M.C.

**Landis, Edwin R.** *See* Hayes, Philip T. 1442

1366 **Langill, F. E.; Hodgson, J. H.** Bibliography of seismology—Items 17127–17944, September–December, 1963: Dominion Observatory Ottawa Pubs., v. 30, no. 3, p. 75–117, 1965.

1379 **Langill, F. E.** Bibliography of seismology, January–April, 1964: Dominion Observatory Ottawa Pubs., v. 30, no. 4, p. 123–153, 1965.

This is part of a series of bibliographies on seismology, which will end with the issue of v. 30, no. 6, September–December 1964. It is possible that the work may be continued under the International Seismological Research Centre in Edinburgh.—M.C.

1399 **Langseth, Marcus G.** Techniques of measuring heat flow through the ocean floor, Chap. 4 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 58–77, illus., 1965.

Heat flow through the ocean floor is determined by measuring the temperature gradient and thermal conductivity in the ocean sediment. Techniques for these measurements are reviewed here, and some comments are made on procedure. Thermal conditions of the ocean bottom are also briefly examined.—Author's abstract

1137 **Larochelle, A.; Black, R. F.; Wanless, R. K.** Palaeomagnetism of the Isachsen diabasic rocks: Nature, v. 208, no. 5006, p. 179, table, 1965.

Redeterminations of the age of two samples of diabasic rocks from south of Isachsen in the Canadian Arctic Archipelago, made in three different laboratories, yield consistent ages ranging from 102 to 110 m.y. This indicates that these rocks are Lower Cretaceous rather than Permian, and removes the conflict with paleomagnetic evidence discussed in an earlier paper (1963). The mean paleomagnetic direction of the rocks discussed in the original paper, including these two, should be considered a fairly reliable one for Lower Cretaceous time with respect to North America.—D.B.V.

1180 **Larochelle, A.** The design of a spinner-type remanent magnetometer: Canada Geol. Survey Paper 64-43, 25 p., illus., table, 1965.

The instrument spins rock cubes at the rate of 255 cycles per second by means of a conical air turbine located at the centre of a solenoidal pick-up coil. Its maximum sensitivity is about $2.2\times10^{-6}$ cgs units per cc. It is adequate for measuring the N.R.M. of most volcanic and extrusive rocks but is not sensitive enough for all rocks that would otherwise be suitable for paleomagnetic work. Its main advantage is that it can be used in laboratories where magnetic-field fluctuations render the operation of an astatic magnetometer impossible. Its drawbacks are common to most magnetometers of this type, namely, it is relatively slow to operate because of delays imposed by the acceleration and deceleration of the rotor and it cannot spin rock samples that are above average in density or friability.—M.C.

1264 **Larson, Allen C.; Roof, R. B., Jr.; Cromer, Don T.** An integrated series of crystallographic computer programs—[Pt.] 10, Anisotropic structure factor calculation and powder pattern generation: Los Alamos Scientific Lab., New Mexico, Rept. LA-3335, 52 p., illus., 1965.

The program was developed to calculate structure factors for a known structure with individual atom thermal parameters in either isotropic or anisotropic form and is being used to calculate phase angles for Fourier analysis procedures, to generate sets of exact data for checking least-squares procedures, and to calculate line intensities for a powder pattern as measured by one of the following techniques: unpolarized or polarized radiation on a cylindrical specimen in a Debye-Scherrer camera; and unpolarized radiation on a flat plate specimen with diffraction vector perpendicular to specimen surface (reflection geometry) or polarized with diffraction vector parallel to specimen surface (transmission geometry). A sample problem on the powder pattern for $UF_4$ and details of procedures are included.—M.C.

1377 **Larson, Lawrence T.; Barnes, Robert H.** Mineral resources summary of the Standing Rock quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 15 p., 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 29-NW by M. V. Marcher (cited separately), and describes the iron ore, limestone, chert, and gravel in Standing Rock quadrangle. Iron ore deposits are for the most part located on hillsides and crests of ridges or ridge spurs which are underlain by siliceous limestones and chert of the Fort Payne, Warsaw, and St. Louis Formations (Mississippian); they are enclosed in chert and clay residuum and commonly are underlain by white kaolinitic clay; the ores are clearly epigenetic and are considered to have been derived from overlying glauconitic Cretaceous sands and gravels. Of the three limestone formations, the Warsaw is most suitable for commercial purposes. Chert is present in all the Mississippian formations. Gravel has been obtained from streams and from pits in the Cretaceous Tuscaloosa Formation.—M.C.M.

1378 **Larson, Lawrence T.** Mineral resources summary of the Hurricane Mills quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 4 p., 1965.

This accompanies Tennessee Div. Geology Geol. Map GM 31-NE by G. K. Moore, et al (cited separately), and describes the limestone and chert in the Hurricane Mills quadrangle. Excavated chert is a product of deep chemical weathering of siliceous Fort Payne Limestone of Mississippian age and has been used for road material. No significant amount of limestone has been quarried and pits have been abandoned. Sand and gravel is a potential resource for local use.—M.C.M.

1379 **Larson, Lawrence T.** Mineral resources summary of the Tennessee City quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 6 p., 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 39-SE by M. V. Marcher and G. K. Moore (cited separately) and describes the gravel in the Tennessee City quadrangle. Accumulations of gravel are found as remnants of the Cretaceous Tuscaloosa Formation, as isolated pods or blankets at higher elevations on or near the crests of ridges or as bars and terraces in or adjacent to streams. Both types have been used for local roads and reserves for this purpose are adequate. Three areas containing evidence of limonite deposits are known but are of doubtful commercial significance. Limestone for local use is available from the Warsaw Limestone.—M.C.M.

1400 **Larson, Lawrence T.** Mineral resources summary of the Waverly quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 7 p., 1965.

This text accompanies Tennessee Div. Geology Geol. Map GM 30-SE by R. E. Lounsbury and C. P. Finlayson (cited separately) and describes the chert, gravel, and limestone in the Waverly quadrangle. Chert is present in the Mississippian Fort Payne, Warsaw, and St. Louis Formations, and all pits have been excavated in residuum of the Fort Payne. Gravel is found as local pockets on crests and slopes of ridges and as bars and terrace accumulations in or adjacent to streams; deposits are generally thin and discontinuous and have little commercial importance. Limestone has been quarried from the Fort Payne Formation.—M.C.M.

1092 **Larson, R. C.** Healdton Arbuckle field and its relationship to other potential Arbuckle structure [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1563, 1965.

1200 **Latus, T. J.** Western Canadian exploration activities, 1964: Canadian Petro Eng., v. 6, no. 3, p. 19–28, illus., tables, 1965.

Most of the exploration interest and significant discoveries in western Canada in 1964 were in the Devonian Gilwood Sand of north-central Alberta, the Leduc reefs and Wabamum Dolomite of west-central Alberta, and the Slave Point reef of northwestern British Columbia. In general the success rate of exploratory and development tests had fallen off slightly from 1963. A table summarizes completions for all of western Canada as well as the individual provinces and territories. M.C.M.

1061 **Laudise, R. A.; Ballman, A. A.; King, J. C.** Impurity content of synthetic quartz and its effect upon mechanical Q: Jour. Physics and Chemistry Solids, v. 26, no. 8, p. 1305–1308, tables, 1965.

Spectrochemical, atomic absorption, and activation analyses of synthetic quartz samples are shown to correlate qualitatively. The Q improved markedly when $Li^+$ was added to the growth solution, but no correlation of Q with any impurity analyzed was found. $Li^+$ concentration decreased outward from the seed probably because of growth rate fall-off with depletion of the nutrient and impedance of circulation in the growing zone. Its increase in the presence of impurities with a valence of plus three is probably a change compensation effect. Absence of Q correlation with $Li^+$ concentration may be due to correlation of Q with some unexamined impurity, presence of $Li^+$ at more than one site, or effect of $Li^+$ on quartz perfection even when not present in the quartz.—M.C.

1338 **Lavergne, P. J.** Field and laboratory methods used by the Geological Survey of Canada in geochemical surveys—No. 8, Preparation of geological materials for chemical and spectrographic analysis: Canada Geol. Survey Paper 65-18, 23 p., illus., 1965.

Laboratory methods for preparation of rock, soil, stream sediment, mineral concentrate, and biological samples for chemical spectrographic analysis are outlined briefly. With slight modifications, these methods can be adapted for use in a field laboratory. Instructions to field men collecting samples emphasize the need of drying samples before shipping and avoiding contamination. Laboratory equipment required for processing the samples includes a rock splitter, a core splitter, a crusher, a pulverizer, a ball mill, mixing table, and a drying cabinet, besides the usual equipment of a laboratory.—M.C.

1119 **Lawson, Donald E.; Smith, Jordan R.** Pennsylvanian and Permian influence on Tensleep oil traps [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1572–1573, 1965.

1317 **Leake, Bernard E.** The relationship between tetrahedral aluminum and the maximum possible octahedral aluminum in natural calciferous and subcalciferous amphiboles: Am. Mineralogist, v. 50, nos. 7–8, p. 843–851, illus., table, 1965.

Critical examination of a plot of 936 available analyses of calciferous and subcalciferous amphiboles leads to the empirical conclusion that the maximum allowed $Al^{IV}$ increases regularly with the maximum $Al^{IV}$. Re-analysis of several analyzed amphiboles showing anomalously high $Al^{IV}$ brought them in line with the others.—E.Z.

1024 **Lee, Kenneth Lester.** Triaxial compressive strength of saturated sand under seismic loading conditions [abs.]: Dissert. Abs., v. 26, no. 2, p. 942, 1965.

1058 **Lee, W. H. K.** (editor) Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), 276 p., illus., tables, 1965.

This Monograph presents an up-to-date review of the fundamentals of terrestrial heat flow. The text includes nine individual papers which are cited separately.—V.S.N.

1001 **Lee, William H. K.; Uyeda, Seiya.** Review of heat flow data, Chap. 6 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 87–190, illus., tables, 1965.

. . . . Analysis of nearby and repeated measurements suggests that regional heat flow variations $>0.2\ \mu$ cal/cm$^2$sec are significant. At the 95 percent confidence level, the world's mean heat flow is $1.5\pm10$ percent $\mu$ cal/cm$^2$ sec, and the average over the continents does not differ significantly from that over the oceans. Heat flow results are well correlated with major geological features. On land, the average and standard deviation of heat flow values are $0.92\pm0.17$ from Precambrian shields, $1.23\pm0.4$ from Paleozoic orogenic areas, $1.54\pm0.38$ from post-Precambrian non-orogenic areas, and $1.92\pm0.49$ from Mesozoic-Cenozoic orogenic areas. At sea, they are $0.99\pm0.61$ from trenches, $1.28\pm0.53$ from basins, and $1.82\pm1.56$ from ridges. On a large scale, a negative correlation between heat flow and gravity is found.—Authors' abstract

1063 **Leech, G. B.** Discussion of "The Rocky Mountain Trench—A problem" [by C. H. Crickmay, 1964]: Canadian Jour. Earth Sci., v. 2, no. 4, p. 405–410, 1965.

Crickmay (ibid., v. 1, p. 184, 1964) attributed development of the Rocky Mountain Trench to stream erosion and minimized the influence of diastrophic structures. Leech believes that stream erosion played a major role but that the Trench is also a partly river-modified diastrophically formed valley, especially in its British Columbia portion. In British Columbia major normal faults occur on its east side and its bedrock floor is structurally continuous with areas to the west. The Trench has great relief with depths below sea level, contains very thick sediments, and is

a combination of tectonic and erosional segments. Leech believes Pleistocene ice caused much erosion while Crickmay ascribes little erosion to it. The St. Eugene sediments are Pliocene to Crickmay and Miocene to Leech.—M.C.

1038 **Lees, John Allen.** Stratigraphy of the Lower Ordovician Axemann Limestone of the Beekmantown Group in central Pennsylvania [abs.]: Dissert. Abs., v. 26, no. 2, p. 985–986, 1965.

1318 **LeMaitre, R. W.** Comments on "A method of classifying analyses with any number of terms" by J. B. Mertie [1964]: Am. Mineralogist, v. 50, nos. 7–8, p. 1131–1133, 1965.

A system of p independent variables can be uniquely defined only by p parameters; the classificatory method proposed by Mertie [ibid., v. 49, nos. 9–10, p. 1306–1320, 1964] therefore is non-unique, as several examples readily show. Mertie, in reply, concedes the invalidity of his method.—E.Z.

**Lesure, F. G.** *See* Huff, L. C. 1150

1087 **Levorsen, A. I.** The obscure and subtle trap [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1566, 1965.

1106 **Levorsen, A. I.** Mid-continent region—Laboratory for petroleum exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1560–1561, 1965.

1443 **Lipman, P. W.** Chemical comparison of glassy and crystalline volcanic rocks: U.S. Geol. Survey Bull. 1201-D, p. D1–D23, illus., tables, 1965.

Results are reported of an investigation of chemical variations between glassy and crystalline parts of 13 volcanic bodies in southern Nevada in order to determine which parts most nearly approximate the original magma in composition. Volcanic glasses were found to be significantly lower in silica and sodium than their crystallized equivalents, apparently as a result of preferential ground-water leaching of the glassy rocks. Analyses of the glassy rocks are unreliable for petrologic purposes.—W.L.G.

1148 **Little, Curtis J.; Carlson, Thomas C.** Many Rocks–Gallup field, San Juan Basin, northern New Mexico [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1575–1576, 1965.

1299 **Lodding, William.** Kaolinite macrocrystals from near Woodstown, New Jersey: Am. Mineralogist, v. 50, nos. 7–8, p. 1113–1114, illus., 1965.

The size distribution of colorless kaolinite platelets shows a double mode with maxima at 15.0 and 0.5 microns. The finest fraction contains 25 percent amorphous hydrous aluminum silicates and 5 percent hydrous iron oxides. Some of the platelets give double (001) reflections at 7.19A and 7.09A. Analysis data are given.—M.L.L.

1197 **Loeblich, Alfred R., 3d.** Type designations for *Dicladia* (Ebriaceae), *Periptera* (Bacillariophyceae), *Gymnoella*, *Phaeodactylis* and *Phaeosphaera* (Radiolaria): Biol. Soc. Washington Proc., v. 78, [art.] 23, p. 189–191, 1965.

In preparation of the forthcoming Treatise on Invertebrate Paleontology, Part B, Protista 1, several genera of microscopic marine organisms were found to lack type species. Type designations are given here for *Dicladia* Ehrenberg, 1844, *D. clathrata* Ehrenberg, 1844; for *Periptera* Ehrenberg, 1844, *P. tetracladia* Ehrenberg, 1844. The radiolarian genera *Gymnocella*, *Phaeodactylis*, and *Phaeosphaera* were proposed by Cachon-Enjumet (1961) with included species, none of which were designated as types; the genera are here validated as new genera by designation of type species: *Gymnocella tregouboffi*, *Phaeodactylis micropyla*, and *Phaeosphaera nucleoelongata*, all described by Cachon-Enjumet (1961).—V.M.J.

1449 **Loewe, F.** Arktis und Antarktis im Lichte neuerer Forschung [with English abs.]: Polarforschung, v. 34, no. 5, pts. 1–2, p. 225–236, 1965.

The paper surveys some recent findings concerning the polar regions, and particularly the ice sheets of Greenland and the Antarctic, in the fields of tectonics, climate, heat economy, glaciology, the temperatures inside the ice sheets, the mass economy and the recently developed isotope methods for the determination of the age and of the stratification of the ice.—Author's English abstract

1025 **Loh, Abraham Kwan-Yuen.** Mechanism of friction and cohesion in clays [abs.]: Dissert. Abs., v. 26, no. 2, p. 942–943, 1965.

**Lounsbury, Richard E.** *See* Wilson, Charles W., Jr. 1290

1397 **Lounsbury, Richard E.; Finlayson, C. Pratt.** Geologic map of the Waverly quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 30-SE, scale 1:24,000, separate text, 1964 [1965].

The accompanying text, "Mineral resources summary of the Waverly quadrangle, Tennessee," by L. T. Larson is cited separately.—M.C.M.

1000 **Lubimova, Elena A.; VonHerzen, Richard P.; Udintsev, Gleb B.** On heat transfer through the ocean floor, Chap 5 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 78–86, illus., 1965.

Heat flow from the Earth's interior may differ from measured values because of several disturbances in the environment on and near the ocean floor. The effects of water movements in and above the sediments are discussed in the light of recent temperature measurements of near bottom water. Superadiabatic gradients have been observed near the ocean floor, suggesting convective overturns, although other factors may inhibit these. The velocity of interstitial water required to affect the surface heat flow is found to be several orders of magnitude less than previously suggested values, although still probably much greater than what is likely to occur. To obtain representative heat flow measurements, other controls are desirable to determine the effects of environment. Alternatively, a large number of observations should be made at a locality to reduce the effect of random variables.—Authors abstract

1050 **Luther, Edward T.; Hershey, Robert E.** Coal map of the Bon Air (Nelson) seam, Morgan Springs quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-SE [sheet 2], scale 1:24,000, 1964.

1051 **Luther, Edward T.; Hershey, Robert E.** Coal map of the Richland seam, Morgan Springs quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-SE [sheet 3], scale 1:24,000, 1964.

1052 **Luther, Edward T.; Swingle, George D.** Mineral resources summary of the Morgan Springs quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 11 p., tables, 1964.

This summary accompanies Tennessee Div. Geology Geol. Map GM 110-SE (1964) and describes the coal, sand, and sandstone resources of the Morgan Springs quadrangle. The Pennsylvanian coal-bearing rocks underlie all but the southeastern and northwestern corners of the area, and the important sources have been the Richland, Bon Air (Nelson), and Morgan Springs coals. Although no mines are currently active, estimated recoverable reserves are about 4 million short tons. Sand from the Rockville Conglomerate and in the Pennsylvanian sandstone formations that cap Walden Ridge, and sandstone from the widely exposed Vandever Formation have been quarried. Potential resources are shale and clay, limestone, and dolomite, chert, and iron.—M.C.M.

1053 **Luther, Edward T.; Swingle, George D.** Mineral resources summary of the Pennine quadrangle, Tennessee: Nashville, Tennessee Div. Geology, 14 p., tables, 1964.

The text accompanies Tennessee Div. Geology Geol. Map GM 118-NW (1964) and describes the coal and sandstone resources of the Pennine quadrangle. The coal-bearing rocks are Pennsylvanian and underlie all except the northwestern and

southeastern corners of the quadrangle. Seams mined or prospected are the Bon Air (Nelson) of the Gizzard Group, and the Sewanee, Lantana, Morgan Springs (Rockhouse), and Nemo (Bumbee) of the Crab Orchard Mountains Group; the latter is the most important and most widely mined. Dimension sandstone from the Crossville Sandstone is present in only a small area in the northeast corner of the quadrangle. Potential resources are chert, limestone and dolomite, sand, shale and clay, and iron ore.—M.C.M.

1055 **Luther, Edward T.** Coal map of the Nemo seam, Pennine quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 118-NW [sheet 2], scale 1:24,000, 1964.

1056 **Luther, Edward T.** Coal map of the Morgan Springs and Lantana coals with data on the Sewanee, Bon Air (Nelson), and Richland coals, Pennine quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 118-NW [sheet 3], scale 1:24,000, 1964.

**Lutsey, Ira.** *See* Beal, Laurence H. 1008

1142 **MacDonald, Gordon J. F.** Geophysical deductions from observations of heat flow, Chap. 7 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 191–210, illus., tables, 1965.

. . . Numerical calculations demonstrate that Earth models which have uranium concentration 3 to 4 times that observed in meteorites and with $K/U = 10^4$ yield the observed heat flow. The computations clearly show that present heat flow implies melting at depth unless either thermal conductivity increases substantially with depth or radioactivity is concentrated at depths less than 300 to 400 km. The general features of temperature–depth curves are similar for many models in which energy is transmitted by radiation as well as by ordinary lattice conduction. The gradient of temperature is high near the surface but decreases within the Earth as the effective conductivity increases with increasing temperature. The temperature distribution depends sensitively on the parameters chosen. The computations do not attempt to account for the initial temperature gradient, nor are nonradioactive heat sources included.—Author's abstract

**MacQuown, W. C., Jr.** *See* Black, Douglas F. B. 1307

1447 **Magnani, M.** Über Mexikanische Gletscher [with English abs.]: Polarforschung, v. 34, no. 5, pts. 1–2, p. 275–278, 1965.

Glaciers in Mexico are located in the tropical zone at about lat 19° N. on high, isolated, volcanic mountains. An analysis of the morphology, alimentation, ablation, and nature of snow and ice is made in relation to possible Pleistocene development. It is concluded that Pleistocene glaciation in Mexico was of slight extent and that reconstruction of the Quaternary must be based on alternating pluvial periods rather than on glacial chronology.—V.S.N.

1019 **Mahony, John Daniel.** Reactions of He-3 with light elements—Application to activation analysis [abs.]: Dissert. Abs., v. 26, no. 2, p. 663, 1965.

**Main, Beveridge J.** *See* Douglas, Archibald G. 1363

1303 **Majumdar, A. J.; Roy, Rustum.** P–T dependence of the sphalerite–wurtzite inversion in ZnS: Am. Mineralogist, v. 50, nos. 7–8, p. 1121–1125, tables, 1965.

The inversion is at least as low as 960°C unless NaCl (which was used as an internal standard) is much more soluble in wurtzite than in sphalerite. The P–T slope of the transition is not known. The difference in volume was determined at 750° and below by X-ray methods. Extrapolation to 1020°C gives about twice the volume change obtained by comparing the two minerals at room temperature.—E.H.R.

**Marcher, Melvin V.** *See* Colvin, John M., Jr. 1057

1289 **Marcher, Melvin V.** Geologic map of the Standing Rock quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 29-NW, scale 1:24,000, separate text, 1964 [1965].

The accompanying text, "Mineral resources summary of the Standing Rock quadrangle, Tennessee," by L. T. Larson and R. H. Barnes is cited separately.—M.C.M.

1396 **Marcher, Melvin V.; Finlayson, C. Pratt.** Geologic map of the Vanleer quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 48-NW, scale 1:24,000, separate text, 1964 [1965].

The text, "Mineral resources summary of the Vanleer quadrangle, Tennessee," by R. H. Barnes, is cited separately.—M.C.M.

1398 **Marcher, Melvin V.; Moore, Gerald K.** Geologic map of the Tennessee City quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 39-SE, scale 1:24,000, separate text, 1964 [1965].

The accompanying text, "Mineral resources summary of the Tennessee City quadrangle, Tennessee," by L. T. Larson is cited separately.—M.C.M.

1127 **Martin, Rudolph.** Application of paleogeomorphology to exploration for oil and gas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1567-1568, 1965.

1248 **Mathias, Mildred E.** Distribution patterns of certain Umbelliferae: Missouri Bot. Garden Annals, v. 52, no. 3, p. 387-398, illus., table, 1965.

Modern world distribution patterns of the angiosperm family Umbelliferae and the closely related, less advanced Araliaceae are plotted from compiled data, and Paleocene-Pleistocene occurrences of species in North America are tabulated. The two families probably derived from a proto-araliaceous stock of the Umbellales, an ancient tropical group already well differentiated in the Cretaceous. The Araliaceae are well known in the Cretaceous of North America and were a component of the tropical Tertiary geofloras. Disjunct distribution of the Umbelliferae in the western hemisphere results from climatic and topographic changes beginning in late Oligocene; in western North America certain elements, adapting to drier climates of the Pliocene, became components of the Madro Tertiary Geoflora.—V.M.J.

**Mattson, P. H.** *See* Briggs, R. P. 1009

1409 **Mauger, Richard L.; Damon, Paul E.** Lead-zinc ore deposition in the light of fluid inclusion studies, Providencia mine, Zacatecas, Mexico: Econ. Geology, v. 60, no. 7, p. 1542, table, 1965.

K-Ar age of muscovite in unreplaced shale bands in ore is 16 m.y., whereas stock with which ore is associated is 40 m.y. old.—W.S.W.

**Maxey, G. B.** *See* Mifflin, M. D. 1140

1313 **Maxey, G. B.; Farvolden, R. N.** Hydrogeological factors in problems of contamination in arid lands: Ground Water, v. 3, no. 4, p. 29-32, illus., 1965.

The ideal hydrogeologic system in arid lands includes a recharge area in the mountains and a discharge area in lowlands, a system modified in nature by geologic and physiographic factors. The concentration of population and agricultural activity in valleys presents water-supply contamination and disposal problems. The suitability of hydrogeologic units for any function of these operations depends primarily on their position within the hydrologic system, and secondarily on physical properties. For example, at the Nevada Test Site nuclear contaminants must travel through considerable thicknesses of valley fill alluvium which fixes them before they reach the carbonate water level, in direct contrast to the conventional means of sewage disposal at Las Vegas, 70 mi to the south.—G.D.C.

1431 **Maxwell, J. A.; Dawson, K. R.; Tomilson, Margaret E.; Pocock, Dorothy M. E.; Tetreault, Diane.** Chemical analyses of Canadian rocks, minerals, and ores compiled from the records of the Geological Survey of Canada for the period 1846–1955 [with French abs.]: Canada Geol. Survey Bull. 115, 476 p., 1965.

Complete or partial chemical analyses of 298 igneous, 185 metamorphic, and 347 sedimentary rocks, 383 minerals, and 97 ores, are presented that were compiled from the published and unpublished reports of the Survey for the period 1846–1955. Each analysis is accompanied by its name, geographic location (both descriptive and according to the National Topographic System Index), geological occurrence, petrographic description, and reference; the specific gravity is included where known. Norms have been calculated for most of the igneous rocks. Related analyses are indicated by a cross-reference system. The report includes a name index, a geographic index, and a list of references from which the analyses were taken.—M.C.

1224 **McBirney, Alexander R.; Williams, Howel.** Volcanic history of Nicaragua: California Univ. Pubs. Geol. Sci., v. 55, 73 p., illus., tables, geol. map, 1965.

Most of Nicaragua is covered by Late Cretaceous and younger volcanics. Cretaceous and early Tertiary lavas (mafic to intermediate), lahars, and subaqueous breccias are abundant in the Central Highlands. Miocene ignimbrites and olivine basalts were deposited on the plains west of the older volcanic centers. Subsequent deformation created a northwest-trending graben which now forms the Nicaraguan Depression. Post-Miocene cones and calderas are mostly concentrated between or along marginal faults of this graben, or to their west. A geologic map (scale ca. 1:2,000,000) and 25 analyses of Quaternary volcanic rocks are included.—G.I.S.

1158 **McConnell, Robert K., Jr.** Isostatic adjustment in a layered earth: Jour. Geophys. Research, v. 70, no. 20, p. 5171–5188, illus., 1965.

In previous studies of the Earth's rheology based on the times required for isostatic adjustment, the possible changes of the properties of rocks with depth have been neglected. Because recent seismological evidence points toward a crust and mantle with strongly contrasting deformational behavior, the theory of relaxation times has been formally extended to a model composed of stratified linear viscoelastic materials. Particular examples of the variation of relaxation times with wavelength for several models consisting of viscous layers, some with overlying elastic layers, are illustrated and compared with values derived from observed post-glacial uplift of Fennoscandia.—Author's abstract

**McCulloh, T. H.** *See* Yerkes, R. F. 1439

**McDonald, Ralph L.** *See* Covington, Robert E. 1104

1425 **McDougall, D. J.** Thermoluminescence of rocks as a prospecting tool–Equipment and methods: Canadian Mining and Metall. Bull., v. 58, no. 640, p. 832–837, illus., 1965.

Thermoluminescence can be caused by radiation as well as by recrystallization, crystallographic transitions, chemical reactions, translation gliding, and stressed conditions in the crystals. Some trace elements enhance, others depress, thermoluminescence. Feldspars and carbonates are the principal minerals used that show thermoluminescence, which may be distinctive for different rock units, differences in metamorphism or differences of alteration and metasomatism, particularly introduction of trace elements. It thus can be used in some cases to show anomalous conditions around an ore body.—A.R.K.

1146 **McGreevy, Laurence J.; Gordon, Ellis D.** Ground water east of Jackson Lake, Grand Teton National Park, Wyoming: U.S. Geol. Survey Circ. 494, 27 p., illus., tables, 1964 [1965].

Test wells were drilled in five localities east of Jackson Lake to evaluate the deposits of Quaternary age as possible sources of ground water. A brief reconnaissance of other parts of the project area was made to establish regional geologic and

hydrologic relations. Limited ground-water supplies of generally good quality can be obtained in most localities, and larger supplies can be developed in parts of Pilgrim Creek valley.—W.L.G.

**McGregor, Alexander A.** *See* Bolyard, Dudley W. 1108

**McKnight, E. T.** *See* Merrill, Charles W. 1190

1405 **McMillion, L. G.** Hydrologic aspects of disposal of oil-field brines in Texas: Ground Water, v. 3, no. 4, p. 36–42, illus., 1965.

In Texas, where 35 percent of the nation's crude oil is produced, brine production and disposal figures for 1961 showed that a total of 2,236,599,746 bbl of salt water were produced from approximately 67,000 oil and gas leases throughout the State. In that year 460,892,427 bbl of salt water were reportedly disposed of into unlined earthen pits, from which they seeped or overflowed to pollute fresh water; and 1,536,543,715 bbl were injected into the subsurface where inadequate well-completion methods may constitute a longer-range problem than surface disposal. Brine-pollution control programs, to safeguard usable water supplies, must regulate standards for the whole range of oil-field operation, equating them with the objective of maximum oil and gas conservation and development.—G.D.C.

1002 **McNitt, James R.** Review of geothermal resources, Chap. 9 *in* Terrestrial heat flow: Am. Geophys. Union Geophys. Mon. Ser., no. 8 (Natl. Acad. Sci.—Natl. Research Council Pub. 1288), p. 240–266, illus., table, 1965.

This chapter introduces the nonspecialist to the field of geothermal energy research by outlining the type and status of geothermal investigations now in progress, summarizing data obtained, and discussing the more difficult problems encountered thus far. Section 2 discusses the history and status of projects in various countries; section 3, the geologic environment of developing thermal areas; sections 4 and 5, thermal and fluid reservoirs and physical characteristics of thermal systems; section 6, chemical investigations; and section 7, problems of exploration. The summary and conclusions are given in section 8. An extensive bibliography is included.—V.S.N.

1223 **Meade, Buford K.** Horizontal crustal movements in the United States: Bull. Géol., no. 77, p. 215–236, illus., tables, 1965.

Surveys in California indicate a generally clockwise fairly uniform horizontal displacement along the northern section of the San Andreas Fault during the past 20 years at an average rate of 1.7 cm per yr, insignificant displacements along the southern section, and possible movement along the Garlock Fault extending to the east about halfway between. The relative displacement in the Imperial Valley is slightly in excess of that along the northern section of the fault, with a rebound motion on the east side. The primary triangulation scheme, originally observed in 1880–85, was reobserved after the San Francisco earthquake of 1906, and again in 1922, after which a systematic program was established at various localities in California, near Fallon, Nev., and near Salt Lake City, Utah.—G.D.C.

1270 **Meinschein, W. G.** Soudan Formation—Organic extracts of early Precambrian rocks: Science, v. 150, no. 3696, p. 601–605, illus., 1965.

Biological-type alkanes are present in rocks of the Soudan Formation that are more than $2.7 \times 10^9$ yr old but evidence of life in Soudan times is marginal. The distributional patterns of the alkanes from various regions in the Soudan indicate an indigenous origin of these compounds. Isotopic analyses do not confirm the compositional analyses.—Author's abstract

1190 **Merrill, Charles W.; McKnight, E. T.; Kiilsgaard, Thor H.; Ryan, J. Patrick.** Silver—Facts, estimates and projections: U.S. Bur. Mines Inf. Circ. 8257, 22 p., illus., tables, 1965.

Moderate increase in industrial use of silver, and large increase in coinage demand, are not being met in the United States or the free world by increase in supply.

Two-thirds of U.S. production comes from base-metal ores and cannot be independently increased. In the next few years, exhaustion of Treasury silver and a free World deficit of 300 to 400 million ounces annually are indicated. At rate of production in 1964 assured U. S. reserves would last about 16 yr, free World reserves about 23 yr, but anticipated increase in industrial demand and limits imposed by mining economics on present sources justify search for and development of additional resources.—R.M.H.

1265 **Merritt, C. A.** Mt. Scott Granite, Wichita Mountains, Oklahoma: Oklahoma Geology Notes, v. 25, no. 10, p. 263–272, illus., table, 1965.

Granite which forms half the outcrop area in the eastern and central parts of the Wichita Mountains is considered a separate and older part of the Wichita Granite Group, and herein named after Mt. Scott which is composed of this rock. It is intruded in the Snyder area by the Lugert Granite, and was originally mapped as this granite. While the two granites resemble each other in mineral composition, they differ in textural features. Most of the Mt. Scott Granite is granophyric with elliptical zoned-feldspar phenocrysts. It was an intrusive sheet of considerable extent beyond the present outcrop area, probably a multiple sill in weak layers of the Carlton Rhyolite Group, and is considered Middle Cambrian in age.—G.D.C.

1048 **Metcalf, Artie Lou.** Fishes of the Kansas River System in relation to zoogeography of the Great Plains [abs.]: Dissert. Abs., v. 26, no. 2, p. 1233–1234, 1965.

1433 **Metzger, William J.** Pennsylvanian stratigraphy of the Warrior Basin, Alabama: Alabama Geol. Survey Circ. 30, 80 p., illus., tables, 1965.

An informal subdivision is proposed for the Pottsville beds in this Pennsylvanian basin of north Alabama, into seven intervals based on the most persistent coal within each of the seven coal groups of McCalley (1900). Crossbedding directions indicate a northeast source area in Tennessee or Georgia, with deposition on a fluvial plain near sea level and periodic marine invasions. Four marine intervals indicate a Morrowan age for the intervals B to E. The faunas appear to be older than those described from Arkansas and Ohio, and floral remains in interval G were identified as equivalent to late-early New River beds in West Virginia. Deposits of the plateau region and its southwest extension, mapped as interval A, are considered lower New River equivalents of the Gizzard Formation of Tennessee. Measured sections are appended and isopach sketch maps included.—G.D.C.

1140 **Mifflin, M. D.; Maxey, G. B.; Domenico, P. A.; Stephenson, D. A.; Hardaway, J. E.** Hydrological investigations . . ., *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 238–364, illus., tables, 1964 [1965].

New hydrologic data on the area not included in a previous paper by Maxey and others (ibid., p. 60–90, 118–147) are presented. The deeper alluvial deposits are described and chemical quality analyses of surface and ground water are reported. Prior to nuclear tests ground water in the area should have had a tritium content of about 4 T. U.; recharge since testing is indicated for four wells where the content now ranges from $5.2\pm0.5$ to $43\pm1.9$ T. U. Study of the water level in six wells and test holes after Project Shoal explosion showed changes ranging from $<0.4$ to $>65$ feet. These data confirm conclusions in the earlier paper which indicate no likelihood of water contamination by Project Shoal outside the immediate vicinity of Sand Springs Range.—M.C.

1427 **Millard, Hugh T., Jr.** Thermal neutron activation—Measurement of cross-section for manganese-53: Science, v. 147, no. 3657, p. 503–504, table, 1965.

The product of the thermal neutron activation cross section and half life of Mn-53 is found to be $(350\pm100)\times10^6$ barn-years; assuming a half life value of $2\times10^6$ yr, the cross section is 170 barns. This large cross section affords much greater sensitivity for the determination of Mn-53 (which occurs in meteorites as a product of cosmic ray reactions).—D.B.V.

1370 **Miller, Ralph L.** Geologic map of the Big Stone Gap quadrangle, Virginia: U.S. Geol. Survey Geol. Quad. Map GQ-424, scale 1:24,000, section, 1965.

1132 **Millison, Clark.** Powder Wash field, Moffat County, Colorado: Mtn. Geologist, v. 2, no. 3, p. 173–179, illus., table, 1965.

The Powder Wash oil and gas field was discovered in 1931, but, after drilling about fifty wells in the last 34 years, the vertical and horizontal limits of the field are far from being defined. It is the second largest and most prolific field in the Sand Wash basin. The prominent surface anticline has about 100 feet of structural closure, and at a depth of approximately 4,000 feet, closure appears to be more than 250 feet. The axial plane and the location of the apex of the anticline shift with depth and indicate that the anticline was growing while Tertiary rocks were being deposited. More than 22 different sandstone zones produce oil and gas and their depth ranges from 2,500 to 8,000 feet. Sandstone zones contain beds that lense in all directions, and the oil, gas, and water have adjusted to the structure. No oil accumulation has been found below 6,000 feet and this may be the result of environmental conditions during Tertiary deposition.—Author's abstract

1201 **Milne, J.; Howie, R.** Eastern Canadian exploration activities, 1964: Canadian Petro Eng., v. 6, no. 3, p. 29–34, illus., tables, 1965.

Exploration drilling in eastern Canada in 1964 decreased from 1963, but development was slightly higher. Commercial production has been limited to southwestern Ontario and the Stony Creek field near Moncton, New Brunswick, although oil and gas shows have been reported from all areas, except the Hudson Bay lowlands and the Atlantic–Continental Shelf area. Tables summarize the exploratory and development drilling.—M.C.

1371 **Mixon, Robert B.** Geologic map of the Haddix quadrangle, eastern Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-447, scale 1:24,000, section, text, 1965.

The main developed mineral resource of the Haddix quadrangle is coal from the Hazard No. 7 bed and the two thicker beds in the Knob coal zone. Areas of thick coal of the Hindman, Haddix, Fire Clay rider, Lower Whitesburg, and Cannel City coal beds have been developed to a limited extent by small drift mines, almost all of which are now abandoned. Oil is produced from a single well about one-half mile north-northwest of Haddix and commercial quantities of gas were encountered in a well (now capped) in the northeastern corner of the quadrangle. Shale in the Breathitt Formation and sand and gravel in alluvium are of potential but probably minor importance.—M.C.M.

1014 **Monroe, Watson H.** Formation of tropical karst by limestone solution and precipitation [abs.], *in* Cong. Latinoamericano Química, 9th, San Juan, Puerto Rico, 1965, Resumenes Trabajos: Río Piedras, Puerto Rico, Colegio de Químicos, p. 38, 1965.

1075 **Moore, Frank B.** Geology of the Millerstown quadrangle, Kentucky: U.S. Geol. Survey Geol. Quad. Map GQ-417, scale 1:24,000, section, text, 1965.

Although gas and shows of oil have been reported in the Millerstown quadrangle, no commercial production has been achieved. Rock asphalt occurs in the Caseyville Formation on and southwest of Buzzard Ridge, the locations suggesting a southwesterly trend for the asphalt deposit. Abundant limestone similar to that quarried from the Ste. Genevieve and Paoli Limestones in nearby quadrangles is present, but has not been exploited.—M.C.M.

**Moore, Gerald K.** *See* Marcher, Melvin V. 1398

1399 **Moore, Gerald K.; Barnes, Robert H.; Wilson, Charles W., Jr.** Geologic map of the Hurricane Mills quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 31-NE, scale 1:24,000, separate text, 1964 [1965].

The text, "Mineral resources summary of the Hurricane Mills quadrangle, Tennessee," by L. T. Larson, is cited separately.—M.C.M.

1076 **Moore, James G.; Krivoy, Harold L.** A reconnaissance gravity survey of the island of Molokai, Hawaii: Pacific Sci., v. 19, no. 3, p. 343–345, illus., 1965.

Gravity surveys were made in 1962–1963 and a map was prepared from measurements from 72 base stations. Like other Hawaiian volcanoes, the West Molokai Volcano showed a well-marked gravity high near the center. Gravity noses trending away from the high both northwest and southeast may define the major rift zones of the volcano. Similar information is lacking for the East Molokai Volcano. A density of 2.3 g/cc was used for the Bouguer corrections.—M.C.

1291 **Moorhouse, W. W.** Stratigraphic position of sulfides in the Archean: Canadian Mining and Metall. Bull., v. 58, no. 641, p. 947–950, 1965.

A survey of recent literature indicates that sulphides occur in the volcanic rocks of the Archean, or in sedimentary rocks intercalated with the volcanic rocks. The thick sedimentary sections are generally poor in sulphides. Thus, the widespread pyrite and pyrrhotite mineralization in the Archean may be largely of volcanic origin.—Author's abstract

**Mooser, Federico.** *See* Alonso Espinosa, Héctor. 1072

**Moran, George.** *See* Cobb, James C. 1203

1044 **Morgan, Nabil Assad.** Geophysical studies in Lake Erie by shallow marine seismic methods [abs.]: Dissert. Abs., v. 26, no. 2, p. 988, 1965.

1228 **Mounce, W. D.** Robert Russell (Tommy) Thompson (1905–1965): Houston Geol. Soc. Bull., v. 8, no. 2, p. 21–22, portrait, 1965.

1242 **Mound, Michael C.** Two new conodont genera from the Joins Formation (lower Middle Ordovician) of Oklahoma: Biol. Soc. Washington Proc., v. 78, [art.] 24, p. 193–200, illus., 1965.

Two new conodont genera and their type species, the new species *Eoneoprioniodus cryptodens* and *Triocladiodus clypeus*, are described from the Joins Formation along U.S. Highway 77 in southern Arbuckle Mountains, Carter County, Okla.; this study is part of a broad program, currently conducted by the California Research Corporation, on conodont faunas in Ordovician rocks. *Eoneoprioniodus* is characterized by blunt, anteriorly directed anticusp, large and deep basal cavity, posterior bar and keel, microdenticles, anterior keel, sinuous basal margin, and cylindroid basal plug; it most closely resembles *Neoprioniodus* Rhodes and Müller, 1956. *Triocladiodus* is characterized by triangular basal outline, three accessory processes, and pyramidal basal cavity; it most closely resembles *Microcoelodus* Branson and Mehl, 1933.—V.M.J.

1337 **Mrose, Mary E.; Schaller, Waldemar T.** The identity of paternoite with kaliborite ($K_2O{\cdot}4MgO{\cdot}11B_2O_3{\cdot}18H_2O$): Am. Mineralogist, v. 50, nos. 7–8, p. 1079–1083, tables, 1965.

The available samples of paternoite, from Monte Sambuco, Sicily, first described as $MgO{\cdot}4B_2O_3{\cdot}4H_2O$ all contain 5–10 percent $K_2O$ and give indices of refraction and X-ray powder diffraction patterns similar to kaliborite, $K_2O{\cdot}4MgO{\cdot}11B_2O_3{\cdot}18H_2O$. Kaliborite has priority as a mineral name.—M.L.L.

1292 **Mulligan, R.** Metallogenic map—Lithium in Canada: Canada Geol. Survey Map 7A, scale 1:7,603,200, text, 1965.

This map accompanies Canada Geol. Survey Econ. Geology Rept. 21 (1965), and shows the distribution of all lithium occurrences in relation to geological features, especially structural provinces and subprovinces, according to current concepts. With the exception of two minor ones in the Cordillera, all Canadian lithium occurrences are pegmatites. All except two deposits of any appreciable size or occurrence are in the Archaean Slave and Superior provinces of the Precambrian Shield; they occur in metasedimentary or metavolcanic rocks or less commonly in

granitic gneisses, near their contacts with granitic intrusions. A list of selected references is included.—M.C.M.

1124 **Murray, George H., Jr.** Quantitative fracture study—Sanish pool, McKenzie County, North Dakota [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1570–1571, 1965.

1412 **Murthy, V. Rama; Compston, W.** Rb–Sr ages of chondrules and carbonaceous chondrites: Jour. Geophys. Research, v. 70, no. 20, p. 5297–5307, illus., tables, 1965.

Determinations of Rb, Sr, and K contents and Sr isotopic compositions are reported for four carbonaceous chondrites, one hypersthene chondrite, and four chondrules from the hypersthene chondrite. The Rb and K abundances are greater in type I than in type III and Sr is relatively constant. An isochron constructed from the carbonaceous chondrite data indicates an age of 4.46±0.35 b.y., using values of $\lambda Rb\text{-}87 = 1.39 \times 10^{-11}$ yr and initial Sr-87/Sr-86 = 0.7007. Inclusion of data for the chondrite changes the age only slightly, to 4.76 b.y. Wide scatter of the chondrule data about this isochron may be explained by "geological error" and possibly increased experimental error.—D.B.V.

1077 **Musgrove, Rufus H.; Barraclough, Jack T.; Grantham, Rodney G.** Water resources of Escambia and Santa Rosa Counties, Florida: Florida Geol. Survey Rept. Inv. 40, 102 p., illus., table, 1965.

The two westernmost counties have abundant ground and surface water of excellent quality. The major aquifer is Miocene to Recent sand-and-gravel, which extends down from the water table 200 to 1,000 feet. Underlying it in the south part only is a Miocene clay unit and, beneath this clay but directly below the upper aquifer in the north, is the Floridan aquifer of limestones separated into upper and lower sections by a clay member of the Byram Formation. Water in the Floridan aquifer is abundant and virtually untapped. Some salt-water encroachment is present but is not a serious problem.—M.C.

1286 **Nagy, J. P.** Preliminary note on the algae of Crystal Cave, Kentucky [with German summary]: Internat. Jour. Speleology, v. 1, pt. 4, p. 478–490, illus., table, 1965.

Collections of a preliminary type carried out here resulted in the identification of seven algal taxa, two of which are reported for the first time from a speleo environment. Except for the cosmopolitan *Oscillatoria neglecta*, no correlation could be found among the algae in Crystal Cave and those of nearby Mammoth Cave. The conclusion is reached that cave flora do not originate from the algal vegetation of the surface, but may have gotten into the caves at the time of the latter's formation.—G.D.C.

1362 **Napp, D. E.** Frio cross section, E–E': Corpus Christi, Tex., Corpus Christi Geol. Soc., 1964.

**Nestell, Merlynd K.** *See* Bostwick, David A. 1192

1143 **Nevada Bureau of Mines; Nevada Mining Analytical Laboratory; Nevada Univ. Desert Research Inst.** Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, 369 p., illus., tables, geol. maps, 1964 [1965].

Studies of the area as a site for the Project Shoal underground nuclear explosion included aerial photography, topographic and geologic mapping, mineralogical examinations, age determinations, test-hole drilling, gravity, magnetic, and refraction surveys, and hydrologic tests. The site was found suitable, in general, for and used for Project Shoal. Individual papers on these various phases of the study are cited separately.—M.C.

**Nevada Mining Analytical Laboratory.** *See* Nevada Bureau of Mines. 1143

**Nevada Univ. Desert Research Inst.** *See* Nevada Bureau of Mines. 1143

**Nichols, C. W.** *See* Dillon, E. L. 1349

1084 **Nichols, Robert L.; Stearns, Charles E.** Fissure eruptions near Bend, Oregon [abs.] (with note by editors), *in* State of Oregon Lunar Geol. Field Conf. 1965, Guidebook: Oregon Dept. Geology and Mineral Industries Bull. 57, p. 8–10, illus., reprinted 1965; originally published 1938.

Since 1938, when this abstract was published, airphotos have revealed a zone of faults and fissures running about N. 30° W. from East Lake in Newberry Crater down the slope of Newberry Volcano, referred to here as "Northwest Rift Zone". A sketch map shows at least eight separate basaltic flows from this zone. Because they are not mantled with pumice ejected during the collapse of Mt. Mazama (Crater Lake site), they are assumed to be younger. The oldest of these has been radiocarbon dated from a tree mold as 6150±210 yr B.P. The youngest is the large aa flow and cinder cone of Lava Butte. In one of the older pahoehoe flows nearby is a lava tube a mile long.—G.D.C.

1315 **Nielsen, G. L.** Ground-water geology of West Coleman, Alberta, Canada: Ground Water, v. 3, no. 4, p. 43–49, illus., 1965.

In an investigation of a high water-table problem west of Coleman, Alberta, ground-water temperatures were found to vary by as much as 12°F at different points within a one-quarter sq mi area. Analysis of temperature distribution, together with ground-water chemistry, and configuration of the water table itself, led to discovery of three distinct sources of ground water: Cordilleran glacial deposits north of the town, an abandoned coal mine underlying the town, and the Crowsnest River. The permeability distribution revealed a major direction of ground-water movement along a former course of the Crowsnest River, although the river was channeled to a different location more than fifty years ago.—G.D.C.

**Nordquist, J. M.** *See* Allen, C. R. 1232

1207 **North American Geologic Map Comm.** Geologic map of North America: Washington, D. C., U.S. Geol. Survey, 2 sheets, scale 1:5,000,000, revised 1965; originally published 1946.

Surveys of North American governments, States of the United States, Provinces of Canada, Greenland, and Iceland; the Geological Society of America, and individual geologists collaborated in the preparation of this revised map. Listed on the map sheet are sources of geologic data for each geographical area, and sources of base map and submarine contours.—M.C.M.

1353 **Nowroozi, Ali A.** Eigenvibrations of the Earth after the Alaskan earthquake: Jour. Geophys. Research, v. 70, no. 20, p. 5145–5156, illus., tables, 1965.

Spectrums of free oscillations of the Earth, computed from long-period pendulum seismograph records obtained at Berkeley and Oroville, Calif., after the Alaskan earthquake of 1964 have been analyzed to yield torsional and spheroidal oscillations. A striking result is the appearance of the ${}_0S_{12}$ mode in the spectrum of longitudinal motion and its absence in that of vertical motion in the Oroville records, indicating that Oroville was near a nodal line for the vertical component of that mode. Variations of spherical amplitudes at both stations indicate an azimuthal order number m=O. The average vertical ground amplitudes of several modes were estimated. The Gutenberg–Bullen A model agrees best with the observations.—D.B.V.

1241 **Nugent, R. C.; Banks, D. C.** Preshot investigations for Project Pre-Schooner, Buckboard Mesa, Nevada Test Site: U.S. Army Corps Engineers Waterways Expt. Sta., Vicksburg, Miss., Rept. PNE-505P, 143 p., illus., tables, 1965.

Geologic and engineering studies were made at four sites selected for the pre-Schooner chemical explosion tests. The area is a 200-ft basalt cap of Quaternary age, of which the upper 25–50 feet are vesicular and grade into 100–150 feet of dense basalt underlain by cinder beds and ash. Average physical property values of the five textural types of samples tested were related to vesicularity. Bulk specific gravity and density were higher in the dense basalt; in both static and dynamic tests the dense basalt had higher unconfined compressive strength and modulus of elasticity. In dynamic tensile splitting, the ultimate strength was higher in dense basalt but the modulus of elasticity higher in the vesicular type. Neutron density and three-dimensional logging were done at one bore hole per site.—M.C.

1162 **Oen, Ing Soen.** Sheeting and exfoliation in the granites of Sermersôq, South Greenland: Medd. om Grønland, v. 179, no. 6, 40 p., illus., 1965; reprinted as Grønlands Geol. Undersøgelse Bull. 49, 1965.

Large-scale sheeting in Precambrian post-tectonic granite on Sermersoq Island occurred, apparently rapidly, in the Pleistocene at the end of the second glaciation. The sheeting is not related to the pre-Tertiary high-level erosion surface or to primary structures in the granite. Review of literature reveals that the combination of large-scale deep sheeting, exfoliation of boulders, and woolsacks is largely restricted to areas of post-tectonic granite massifs, and that regional uplift commonly preceded sheeting. It is concluded that insolation, weathering, climate, texture and composition are secondary factors; the main cause is dilatation following release of pressure. Gravity anomalies of post-tectonic granite massifs are compensated during regional uplift; when uplift ceases, decompression of combined gravity and epeirogenic forces occurs rapidly, and surface rocks exfoliate spontaneously.—V.M.J.

1352 **Oilweek.** Riches from Prairie Evaporite: Oilweek, v. 16, no. 38, p. 29–30, illus., 1965.

Saskatchewan potash reserves occur in well-defined beds and zones near the top of the Prairie Evaporite Formation of the Middle Devonian Elk Point Group which consists of the Ashern Formation (shaly), the Winnipegosis (dolomitic rocks with sporadic evaporite near the top), and the Prairie Evaporite (potash, salt, and anhydrite). The latter reaches a thickness of more than 600 feet.—M.C.M.

1226 **Olsen, Stanley J.** Vertebrate fossil localities in Florida: Florida Geol. Survey Spec. Pub. 12, 28 p., illus., 1965.

The only formations exposed at the surface in Florida in which vertebrate fossils have been found, range in age from Eocene through Pleistocene. Two older subsurface fossils found in drilling are a Cretaceous turtle in 1955 and a Middle Ordovician trilobite in 1944. Dinosaurs are not likely to be found because the rocks that might contain them are thousands of feet below the surface. Vertebrate fossils found in the north and central parts of the State in both terrestrial and marine Cenozoic sedimentary rocks include a varied assemblage. A section is devoted to methods and techniques to be used in collecting fossil vertebrates.—M.C.

**Olson, Richard H.** *See* Beal, Laurence H. 1008

1222 **Oppenheimer, Carl H.; Wood, E. J. Ferguson.** Quantitative aspects of the unicellular algal population of the Texas bay systems [with Spanish summ.]: Bull. Marine Sci., v. 15, no. 3, p. 571–588, illus., tables, 1965.

A study was made of the possible relations between some physical and chemical factors in the Texas Bay sediments and the number of photosynthetic microorganisms contained therein. The diatom species found in these sediments were studied in relation to such factors as water depth, pH, Eh, salinity range and sediment type. Neither the number of organisms encountered in the sediment nor the species found at different localities showed any identifiable correlation with the environmental factors assessed. Either the distribution of organisms was controlled by factors which were not studied or it was due to biological rather than physiochemical factors.—Authors' abstract

1372 **Oriel, Steven S.** Preliminary geologic map of the SW 1/4 of the Bancroft quadrangle, Bannock and Caribou Counties, Idaho: U.S. Geol. Survey Mineral Inv. Field Studies Map MF-299, scale 1:24,000, 1965.

1210 **Ott, Emil.** Magnetic profiles along mineralized fissure in the Quitman Mountains of West Texas, U.S.A.: Eclogae Geol. Helvetiae, v. 58, no. 1, p. 449-451, illus., 1965.

Six magnetic profiles were made across an altered and mineralized (mainly lead and zinc) porphyry dike intruding an igneous massif in the Quitman Mountains. The magnetic susceptibility of the minerals in the dike is very low, some even being diamagnetic (negative susceptibility), whereas the susceptibility of the country rock is high. The contrast shows readily in the profiles, showing that such veins can be located and traced under alluvium by magnetic surveys; it also may be possible to determine the dip of the mineralized layer.—D.B.V.

1147 **Ott, Henry L.** Palynology and its use in petroleum exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1567, 1965.

1215 **Packer, R. W.** Lag mound features on a dolostone pavement [with French summ.]: Canadian Geographer, v. 9, no. 3, p. 138-143, illus., 1965.

Silurian dolostone of the Amabel and Guelph Formations occurs in the Bruce Peninsula, Ontario. At Nipissing shoreline, 640-650 feet above sea level, rock is partly lichen-covered and deeply fissured into a typical limestone pavement pattern, lapies. Toward the offshore zone, rock blocks of similar size, separated by fissures with rounded sides and 1-18 in. wide, and up to 1 ft deep, have rounded cross-sections and smooth surfaces. These natural features may be patterned ground remnants of periglacial conditions, soil and rock remnants pushed up by tree boles, or lag features resulting from subsoil removal of material down grykes, the latter being most likely. They occur elsewhere in southern Ontario and seem to indicate the start of karst development, so may serve as guide to distinguish between active and fossil karst.—M.C.

1284 **Parker, Everett C.** William Frederick Howell (1895-1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1533-1544, portrait, 1965.

1419 **Peach, Peter A.; Renault, Jacques R.** Statistical analysis of some characteristics of British Columbia molybdenite occurrences: Econ. Geology, v. 60, no. 7, p. 1510-1515, tables, 1965.

One hundred nine British Columbia molybdenite occurrences are arranged into deposit types characterized by (1) quartz veins and lenses, (2) fractures and shears, (3) dissemination, (4) contact metasomatism, and (5) brecciation. The dependence of these deposit-types on rock-type is tested by means of chi-square enumeration statistics, and it is determined that deposit-type is a function of rock-type. It is concluded that molybdenite deposition is principally controlled by an igneous process and/or a property of igneous rocks.—Authors' abstract

1387 **Pearl, Richard M.** Colorado gem trails and mineral guide (2d revised edition): Denver, Colo., Sage Books, 223 p., illus., 1965; originally published 1958.

This book, intended to compliment the author's *Colorado rocks, minerals, fossils*, gives directions to the best collecting localities in Colorado, especially in the central part and the Denver area. Latest information is given on local travel, collecting conditions, and land ownership, along with detailed directions to described localities, aided by mileage logs, sketch maps, and highway maps. Directories of mineral societies and museums, references for further study, and lists of official maps are given. Gem and mineral societies that welcome visitors, and museums that display outstanding collections are described.—G.D.C.

1206 **Pearson, John E.; Jones, Gary E.** Emanation of radon 222 from soils and its use as a tracer: Jour. Geophys. Research, v. 70, no. 20, p. 5279-5290, illus., tables, 1965.

The temporal, geophysical, and geographic parameters related to the emanation of Rn–222 at the earth–atmosphere interface have been studied. A system for collecting Rn–222 emanating at the Earth's surface with a minimum of disturbance to the site is described. Statistical analysis of emanation data with respect to location, soil type, meteorological conditions, and other parameters was made of selected sampling patterns in east-central Illinois; a variation with wind speed, gustiness, and soil moisture was observed. Criteria are given for selecting locations favorable for vertical diffusivity studies using Rn–222 as a tracer.—D.B.V.

1407 **Penner, E.** A study of sensitivity in Leda clay: Canadian Jour. Earth Sci., v. 2, no. 5, p. 425–441, illus., tables, 1965.

In the Ottawa area, Ontario, sensitivity or ratio of natural shear strength to remolded strength of Leda clay is relatively independent of the salt content of pore water. Values may vary between 10 and 1,000 in the low salt content range but strong flocculating effects of the electrolyte limit sensitivity at higher salt contents. A relationship consistent with the theory of interparticle repulsion and attraction has been determined experimentally between electrokinetic potential and sensitivity, with main deviations caused by differences in grain size. Chemical analyses of pore water show that large sensitivity variations within one profile are related to the nature of the pore water electrolyte in the low salt content range. Unusually sensitive soils have a high monovalent cation content, which explains large sensitivity differences but not small ones.—M.C.

1121 **Peterson, James A.** Stratigraphic vs. structural controls on hydrocarbon accumulation in Aneth area, Paradox basin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1571–1572, 1965.

1081 **Peterson, N. V.** Newberry Volcano area field trip—Geologic summary, *in* State of Oregon Lunar Geol. Field Conf. 1965, Guidebook: Oregon Dept. Geology and Mineral Industries Bull. 57, p. 11–18, illus., geol. map, 1965.

The prehistoric Newberry Volcano, 25 mi south of Bend, has a broad shield basal diameter of 20 mi, and the highest point on its caldera rim is 7,985 feet above sea level, about 4,000 feet above the basalt plain. Inside the caldera are two large lakes separated by pumice cones, basaltic tuff rings, and four distinct flows of obsidian; dating of charred logs in the topmost layers of pumice shows that the latest eruptions were no more than 2,054±230 yr ago. The outer slopes have abundant cinder cones and flows of stark, black lava. In the history of the volcano, after it had reached its maximum size, eruptions of basaltic lava from fissures low on the flanks drained the central pipes, withdrawing support of the top which collapsed along concentric fractures.—G.D.C.

1151 **Peterson, N. V.; Groh, E. A.** (editors) State of Oregon Lunar Geological Field Conference, Bend, Oreg, 1965, Guidebook: Oregon Dept. Geology and Mineral Industries Bull. 57, 51 p., illus., geol. maps, 1965.

This conference, organized by the University of Oregon Department of Geology and the New York Academy of Sciences, highlights geological relationships between the Earth and the Moon. Oregon has the largest area of Tertiary and Recent volcanics of any state in the conterminous United States. The central Oregon area around Bend has a great diversity of lava types and landforms within a short radius, and accessible with a minimum of difficulty. This guidebook gives a brief introduction to the potential of the area, both as an outdoor laboratory for the study of volcanics and as a site for some of the research prerequisite to establishing a manned base on the Moon, and for the enjoyment of the layman and tourist.—G.D.C.

**Petri, L. R.** *See* Cotter, R. D. 1402

1246 **Phillips, Tom L.; Andrews, Henry N.** A fructification of *Anachoropteris* from the Middle Pennsylvanian of Illinois: Missouri Bot. Garden Annals, v. 52, no. 3, p. 251–261, illus., 1965.

An unattached massive compact fructification, apparently a fertile pinna, of *Anachoropteris* sp. is described. The coal ball was collected at the Sahara Coal Co. mine, 4 miles northwest of Carrier Mills, Ill., from the Illinois No. 6 (Herrin) coal of the Carbondale Formation. Outstanding features are a distinctly anachoropterid xylary strand in the central axis, the sporangial aggregation and compact pinnate arrangement, the multiseriate annulus of the sporangium with a pseudoapical plate, and spores congeneric with *Raistrickia*. Comparisons are made with *Botryopteris globosa*.—V.M.J.

**Pickering, J. W.** *See* Holcomb, C. W. 1358

1360 **Plant, C. E.; Ammer, B.** Frio cross section, C–C′: Corpus Christi, Tex., Corpus Christi Geol. Soc., 1964.

**Pocock, Dorothy M. E.** *See* Maxwell, J. A. 1431

1324 **Powell, J. L.** Low abundance of Sr–87 in Ontario carbonatites: Am. Mineralogist, v. 50, nos. 7–8, p. 1075–1079, table, 1965.

The Sr–87/Sr–86 ratios for 10 Ontario carbonatites vary between 0.7019 and 0.7037, and average $0.7028 \pm 0.0006$ ($\sigma$). These results strengthen the validity of the Sr–87/Sr–86 ratio to distinguish between carbonatites and limestones or marbles. Comparison with data for mafic continental rocks and limestones (generally higher than 0.704 and 0.706 respectively) indicates that these carbonatites are not mobilized limestones but are derived from below the sial and possibly from the mantle, and probably are generated independently of tholeiitic basalt magma. Although the carbonatites have risen through tens of kilometers of ancient sialic rocks of the Superior Province, they have retained their characteristically low Sr–87/Sr–86 ratio and have not been enriched in Sr–87 by contamination.—B.C.H.

1155 **Press, Frank.** Resonant vibrations of the Earth: Sci. American, v. 213, no. 5, p. 28–37, illus., 1965.

Major earthquakes cause the entire Earth to vibrate like a ringing bell. These vibrations are very slow and are extremely valuable in that they allow an analysis of the oscillating medium that is independent of the exciting mechanism. Current research is exploring the degree to which different layers of the Earth tend to dissipate energy, and results suggest that the upper mantle is weak, supporting the isostasy theory. Other workers are using slow waves to study density distribution within the Earth and as a means of approximating fault length and rate of rupture.—A.A.D.

1383 **Prickett, T. A.; Hoover, L. R.; Baker, W. H.; Sasman, R. T.** Ground-water development in several areas of northeastern Illinois: Illinois Water Survey Rept. Inv. 47, 93 p., illus., tables, 1964.

The five areas studied are the Hadley Valley area near Joliet, Woodstock area, Libertyville area, Chicago Heights area, and LaGrange area. The aquifers which supply all needs are a Quaternary sand and gravel strip for the Hadley Valley and Woodstock areas, and, for the other three, an unnamed Silurian dolomite, which occurs at depths of less than 300 feet and has ground water in joints, fissures, and solution cavities. In all five areas, the practical sustained daily yield in the well fields exceeds the average pumping rates recorded in 1961 and 1962. Studies of specific capacities of wells and pumping centers both inside and outside the five areas indicate that large amounts of water are being obtained from the two aquifers throughout most of northeastern Illinois.—M.C.

**Prior, C. H.** *See* Cotter, R. D. 1402

1125 **Radella, Frank A.** Nisku of northeastern Montana with special reference to Tule Creek area, Roosevelt County, Montana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1570, 1965.

1305 **Raguin, Eugène.** Geology of granite (translated from 2d French edition by E. H. Kranck, P. R. Eakins, and Jean M. Eakins): New York, Interscience Publishers, 314 p., illus., 1965; originally published 1957.

In his definition of granite the author distinguishes circumscribed massifs and anatectic granites. The six chapters treat the petrography, the mode of occurrence of the two categories, the assimilation of formations in contact with granite, the aureole of metamorphism, the internal structure of massifs from the geometry and facies of variation, and vein satellites. All of these phenomena are likely to be well developed in massifs, but much less well-defined in anatectic granites. After treating the destruction of granite by alteration and crushing, broader points of view are discussed—comparisons with metamorphism, orogeny and volcanism, metallogenesis, and radioactivity. Granite is then fitted into the framework of the Earth's crust, and the final chapter returns to the problem of the formation of granites.—G.D.C.

1181 **Raleigh, C. B.** Glide mechanism in experimentally deformed minerals: Science, v. 150, no. 3697, p. 339–341, illus., 1965.

A method for study of mechanisms of twin and translation gliding in minerals in rocks has been devised by which slip markings produced experimentally on polished surfaces are related to crystallographic planes by universal stage measurements of the crystal orientations. In specimens strained 5 to 10 percent at 5 to 7 kilobars confining pressure and 700° to 850°C, the glide plane and glide direction for slip and twinning have been determined in olivine, enstatite, kyanite, and diopside. Slip occurs in closest-packed directions, in which also lies the shortest Burgers vector of a unit edge dislocation in the slip plane.—Author's abstract

1365 **Rama, S. N.; Hart, S. R.** Neon isotope fractionation during transient permeation: Science, v. 147, no. 3659, p. 737–738, illus., 1965.

Fractionation of Ne-20 with respect to Ne-22 during a single-stage transient permeation experiment results in as much as 45 percent enrichment of Ne-22. The observed fractionations agree with those calculated from simple diffusion theory. Fractionation may occur in nature by similar processes; this might be partly responsible for some of the isotopic anomalies observed, for example, in the meteorites.—D.B.V.

1300 **Raman, K. V.; Jackson, M. L.** Rutile and anatase determination in soils and sediments: Am. Mineralogist, v. 50, nos. 7–8, p. 1086–1092, illus., table, 1965.

Small quantities of rutile or anatase in soils and sediments can be positively identified after preliminary concentration effected by dissolution of the silicate phases in cold HF. The $TiO_2$ content of the residue can be determined by a colorimetric method. The procedures are given in detail, along with precautions.—E.Z.

1013 **Ramírez Torres, Osvaldo; Caballer de Pérez, Celeste; Cabrera, Rosaida.** Estudio delos depósitos de laterita y serpentina descompuesta de Mayagüez como fuente de minerales [abs.], *in* Cong. Latinoamericano Química, 9th, San Juan, Puerto Rico, 1965, Resumenes Trabajos: Río Piedras, Puerto Rico, Colegio de Químicos, p. 37, 1965.

1015 **Ramírez Torres, Osvaldo; Caballer de Pérez, Celeste.** Analysis de cobre en minerales—Resultados comparativos del método espectrofotométrico y método tiocianato-iodométrico [abs.], *in* Cong. Latinoamericano Química, 9th, San Juan, Puerto Rico, 1965, Resumenes Trabajos: Río Piedras, Puerto Rico, Colegio de Químicos, p. 76–77, table, 1965.

**Rao, S. V. L. N.** *See* Berry, L. G. 1304

**Renault, Jacques R.** *See* Peach, Peter A. 1419

1325 **Reynolds, Robert C., Jr.** An *X*-ray study of an ethylene glycol-montmorillonite complex: Am. Mineralogist, v. 50, nos. 7–8, p. 990–1001, illus., table, 1965.

A structural analysis based on intensity data from basal reflections through 00.14 of an ethylene glycol–montmorillonite complex indicates that the glycol molecules form a staggered, two-layered complex. Water molecules and exchangeable cations lie close to the plane separating the two glycol layers.—M.L.L.

1219 **Rice, H. M. A.** 1964 index of publications of the Geological Survey of Canada: Canada Geol. Survey Paper 65–3, 110 p., 1965.

This index lists publications issued mainly in 1964 and serves as an additional supplement to previous lists. It contains also a list of papers by officers of the Geological Survey published in various scientific periodicals.—M.C.M.

1134 **Richards, Adrian F.** Linear relationship between energy and pressure of volcanic explosions: Nature, v. 207, no. 5004, p. 1382–1383, 1965.

A plot of published data on the energies and pressures of a number of explosions of Asama and that of Bezymyannyy in 1956 shows an eye-fitted linear relationship between the log of kinetic energy and the log of gas pressure, expressed by the equation $E = 10^{9}P^{4.2}$ (energy in ergs and pressure in atm or bars). More data are needed to determine the validity of this relationship throughout the range of pressures and energies associated with volcanic eruptions.—D.B.V.

1107 **Richardson, W. E.** Oswego Limestone facies change in Mid-continent region [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1561, 1965.

**Richter, C. F.** *See* Allen, C. R. 1232

1093 **Riley, L. R.** Challenge of deep exploration—Chitwood Pool, Grady County, Oklahoma [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1563, 1965.

1254 **Rinehart, C. Dean; Huber, N. King.** The Inyo Crater Lakes—A blast in the past: California Div. Mines and Geology Mineral Inf. Service, v. 18, no. 9, p. 169–172, illus., 1965.

The craters here mark a recent, relatively small event in recurrent volcanic eruptions that built the more imposing Mono Craters and Mammoth Mountain. In the intervening area, except for a few volcanic domes, the youngest material is pumice, much of which appears to have erupted from a line of vents and blanketed older rock to varied depths. After the pumice, viscous lava pushed through the vents to form obsidian and rhyolite domes. Three rock units in the crater walls, recording events preceding the explosions as well as the explosions themselves, are described as: A, andesite lava; B, layered volcanic ash and pumice, and C, heterogeneous mixture. Unit C, found only in the immediate vicinity of the craters, is the latest ejection. Charred fragments in the pumice date that eruption at about A. D. 365.—G.D.C.

1152 **Rinehart, J. S.** Earth tremors generated by Old Faithful Geyser: Science, v. 150, no. 3695, p. 494–496, illus., 1965.

Several types of earth tremors that could be associated with the eruption cycle of Old Faithful Geyser were registered by a seismograph placed a few meters from the geyser's orifice. Each tremor type was indicative of a specific geyser action. A totally unexpected result was an observed bimodal distribution in frequency of the interval between eruptions.—Author's abstract

1388 **Robertson, Forbes.** Physical geology—Manual of laboratory exercises (2d edition): Minneapolis, Minn., Burgess Publishing Co., 166 p., illus., 1965; originally published 1961.

The manual, thoroughly revised from the first edition, is designed for the student taking his first (and perhaps only) course in geology, but should be used in conjunction with field trips.—M.C.M.

1266 **Robertson, Herbert.** Physical and topographic factors as related to short-period wind noise: Seismol. Soc. America Bull., v. 55, no. 5, p. 863–877, illus., tables, 1965.

Median values of seismic noise in the period range of 0.3–1.3 sec obtained at vaults of the Pole Mountain (Wyoming) array ranged from 0.91 to 2.20 $\mu$ in November 1962. The former value was obtained for a vault located in dense granite at the base of a massive granite outcrop, the latter for a vault in a slab of dense granite on a grassy plain. To test the idea that topographic shielding rather than bedrock density affected noise, wind protection numbers were assigned to 9 vaults of the Wichita Mountains Seismological Observatory array, based on comparative topographic shielding with respect to a known wind direction. Noise values increased as wind noise decreased; topographic protection and vault construction limited the noise.—D.B.V.

1225 **Robinson, E. A.; Treitel, S.** Principios del filtrado digital: Asoc. Mexicana Geofísicos Explor. Bol., v. 6, no. 2, p. 81–112, 1965.

This is a translation into Spanish of the paper published in Geophysics, v. 29, no. 3, p. 395–404, 1964.—V.S.N.

1415 **Roedder, Edwin.** Report on S.E.G. symposium on the chemistry of the ore forming fluids: Econ. Geology, v. 60, no. 7, p. 1380–1403, 1965.

Sessions included presentations and discussions of the following topics: mineral stability and phase assemblages at ore-forming temperatures and pressures; high-temperature solution chemistry of sulfides, carbonates, and silicates, with consideration of complexing and stability, and the generation of ore fluids; hydrothermal fluids as deduced from wallrock alteration, from fluid inclusions and hot springs, from isotopic studies, and from mine studies, zoning, and so forth.—W.S.W.

**Roof, R. B., Jr.** *See* Larson, Allen C. 1264

1395 **Roscoe, S. M.** Geochemical and isotopic studies, Noranda and Matagami areas: Canadian Mining and Metall. Bull., v. 58, no. 641, p. 965–971, illus., tables, 1965.

. . . Assemblages of minor elements in pyrites and pyrrhotites of the Noranda and Matagami deposits are similar and are characterized by a high content of cobalt, tin and other elements. Isotopic compositions of lead, other geochronological data, and stratigraphically disposed zonal distributions of sulphides and minor elements indicate that the deposits were formed prior to folding and metamorphism. Lead isotope data indicate that the Matagami deposits, and several others, were probably formed about $2.95 \times 10^9$ yr ago and that the Noranda deposits may be about 50 m.y. younger. The volcanic sequence at Noranda is younger than the thick sequences bordering it on the east and west. Relationships are consistent with the hypothesis that these strata-bound sulphide deposits are coeval with their associated volcanic rocks.—Author's abstract

1039 **Rosholt, John Nicholas, Jr.** Uranium in sediments [abs.]: Dissert. Abs., v. 26, no. 2, p. 986, 1965.

1040 **Ross, David Alexander.** The sediments and structure of the northern Middle America Trench [abs.]: Dissert. Abs., v. 26, no. 2, p. 986, 1965.

1416 **Roy, M. M.** Studies on coal macerals—[Pt.] 4, Chlorination of exinite and fusinite Econ. Geology, v. 60, no. 7, p. 1404–1410, tables, 1965.

Products of chlorination suggest "that in exinite a greater proportion of disordered structure is present, and the number of condensed aromatic rings is not more than two; sulfur is more firmly bound; the number of peripheral groups is greater. Fusinites have more condensed structures, the number of hydroaromatic structures is negligible, and the number of condensed rings present is more than two."—From author's abstract

**Roy, Rustum.** *See* Stubican, V. S. 1196

**Roy, Rustum.** *See* Majumdar, A. J. 1303

**Roy, Rustum.** *See* Weber, Jon N. 1326

1217 **Rudman, Albert J.; Blakely, Robert F.** A geophysical study of a basement anomaly in Indiana: Geophysics, v. 30, no. 5, p. 740–761, illus., tables, 1965.

Seismic, gravity, aeromagnetic, and vertical and horizontal magnetic surveys in Indiana were interpreted collectively in a prescribed sequence that led to information ordinarily not obtained from the individual surveys. Prominent reflections and sharp, coincident magnetic and gravity anomalies in Pulaski County indicate a roughly circular body with its top at a depth of 1.4 km, 2.5 km in vertical thickness and 29 sq km in area, magnetic susceptibility contrast of 0.0088 cgs and density contrast of 0.21 g per $cm^3$. This is interpreted as a basalt plug intruded into the granitic basement, possibly one of a series of vents along the Cincinnati arch that were the source for Precambrian basalt flows in Indiana.—D.B.V.

**Rukavina, N. A.** *See* Sutton, R. G. 1164

1309 **Russell, Loris S.** Tertiary mammals of Saskatchewan—Pt. 1, The Eocene fauna: Toronto Univ. Royal Ontario Mus. Life Sci. Contr. 67, 33 p., illus., 1965.

Tertiary mammals found so far in Saskatchewan have been restricted to the southwestern part, in plateau areas such as Cypress Hills, Swift Current plateau, and Woods Mountain plateau. Part 1 of this series of reports consists of introduction, general geology (stratigraphic summary), and descriptions of the Eocene mammalian fauna; Oligocene and Miocene faunas will be described later. All Eocene mammals, designated as the Swift Current Creek fauna, are from one exposure of the Swift Current Creek beds southeast of Swift Current. Single teeth or jaw fragments represent 16 species or undetermined taxa of Insectivora, Lagomorpha, Rodentia, Carnivora, Condylarthra, Perissodactyla, and Artiodactyla. The fauna closely resembles that of the Late Eocene Upper Uinta Formation (Myton Member) of Utah.—V.M.J.

1005 **Rutledge, E. M.; Horn, M. E.** The Dickson and Zanesville soils of Washington County, Arkansas—[Pt.] 1, Their properties and genesis: Soil Sci. Soc. America Proc., v. 29, no. 4, p. 437–443, illus., tables, 1965.

Although these two fragipan soils are underlain by different bedrock, data on three profiles of each series are similar. High silt contents suggest a loess parent material but chemical and mineralogical data and other data on particle-size content suggest that much of the silt is probably derived from the weathering of underlying rocks. Loess, if present, is only a minor component and unimportant to the genesis and classification.—E.S.L.

**Rutledge, E. M.** *See* Horn, M. E. 1006

**Ryan, J. Patrick.** *See* Merrill, Charles W. 1190

1154 **Sabina, Ann P.** Rocks and minerals for the collector—Northeastern Nova Scotia, Cape Breton, and Prince Edward Island: Canada Geol. Survey Paper 65–10, 76 p., illus., table, 1965.

The occurrences of minerals, rocks, and fossils are described for 75 easily accessible localities in the area. A few rocks and minerals are suitable for ornamental purposes but most deposits furnish specimen material only and gem minerals are not known in the area. Also included are a list of references to geological reports giving further information on the rock and mineral deposits and a glossary of rock and mineral names and terms.—M.C.

**Sachs, Peter L.** *See* Hathaway, John C. 1316

**Saint Amand, Pierre.** *See* Allen, C. R. 1232

1348 **Salas, Guillermo P.** Resultados de trabajos realizados durante el ejercicio 1963 y programa para 1964: México Univ. Nac. Autónoma Inst. Geología Anales, v. 22, 42 p., illus., 1964.

Results of projects in areal geology, stratigraphy, paleontology, geochemistry, and other fields, carried out by the Institute of Geology during the fiscal year 1963, are summarized briefly; the program for 1964 is outlined.—V.M.J.

1218 **Sando, William J.** Revision of some Paleozoic coral species from the Western United States: U.S. Geol. Survey Prof. Paper 503-E, p. E1-E38, illus., table, 1965.

Type specimens of 12 coral species (10 rugose, 2 tabulate) described as Carboniferous forms by J. Hall (1852), C. A. White (1875-80), and F. B. Meek (1873-1877), in reports of the early Federal geological surveys of the Western States, are herein redescribed and illustrated from restudy by modern thin-section techniques, and lectotypes are selected. The strata from which the specimens were collected are now considered Ordovician or Silurian, Mississippian, Pennsylvanian, and possibly Permian in age. Six of the species are retained, under different generic names; one is placed in synonymy of another species, four are regarded as nomina dubia, one is rejected. Specimens that were incorrectly assigned to the species are also discussed and illustrated. Synonymies are compiled for each species.—V.M.J.

1434 **Sanford, Thomas H., Jr.** Ground-water conditions in the Huntsville area, Alabama, January 1960 through June 1961: Alabama Geol. Survey Circ. 24, 46 p., illus., tables, 1965.

The Tuscumbia Limestone and Fort Payne Chert of Mississippian age are the principal water-bearing formations underlying the valleys in the Huntsville area. Openings along fractures and bedding planes serve as conduits for large quantities of ground water. This report is chiefly a record of water-level fluctuations and spring discharge, and chemical analyses of the water relative to dissolved minerals, carbon dioxide, temperature, and length of time the water is in contact with rock. The results indicate moderately hard to very hard water of good chemical quality, recharged by evenly distributed precipitation.—G.D.C.

**Sasman, R. T.** *See* Prickett, T. A. 1383

1113 **Saterdal, A.** Lower Cretaceous oil fields of northern Sweetgrass arch, Montana [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1573-1574, 1965.

1173 **Schaeffer, Bobb.** Louis Hussakof [1881-1965]: Soc. Vertebrate Paleontology News Bull. 75, p. 52, 1965.

**Schaller, Waldemar T.** *See* Mrose, Mary E. 1337

0991 **Schilling, John H.** Potassium-argon ages of the granitic intrusive rocks, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 159-164, illus., table, 1964 [1965].

Six potassium-argon age determinations were made on biotite from one granite, two aplite-pegmatite, and three granodiorite specimens from the Sand Springs Range. Apparent ages, in millions of years, are: for granite, 79.6±2.0; for aplite-pegmatites, 31.5±3.0 (weathered sample) and 66.0±4.0 (fresh sample); and for granodiorites, 75.0±2.0, 87.5±1.0, and 83.6±3.5. The ages and other geologic evidence show that the main granite-granodiorite body, stocks, and aplite-pegmatite dikes of Sand Springs Range all were emplaced during a single period of igneous activity lasting for at least 10 m.y. in Late Cretaceous time.—M.C.

0993 **Schilling, John H.** Exposure of minerals and other substances to high-pressure shock-waves, *in* Geological, geophysical, . . . investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 193-202, illus., table, 1964 [1965].

The purpose of the experiment was to show the effect of the Project Shoal nuclear explosion on a variety of minerals, rocks, chemicals, and other substances placed in canisters in a drift at distances ranging from 30 to 320 feet from the detonation point and at shock pressures of 1 to over 500 kilobars. Nine Nevada Bureau of Mines canisters each contained 12 feldspar samples, one granite sample, biotite flakes from quartz monzonite, and a sample each of gypsum, quartz, basalt, and limestone. Penn State canisters contained granite, sandstone, coal, common rock-forming minerals, and chemicals. Richfield Oil canisters contained oil sands. All must be recovered before final effects of shock waves on them can be determined.—M.C.

1007 **Schilling, John H.** Geographic setting, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 20–23, illus., table, 1964 [1965].

The Sand Springs Range is the Great Basin portion of the Basin and Range province and is a north-trending mountain flanked on the east by the Fairview Valley and on the west by Fourmile Flat. Much of the northern half is a rolling plateau with low relief and bordered by steep scarps on the east and west. The southern half is dominated by a north-west-trending ridge with summits averaging 6,600 to 6,800 feet and a steep east flank and gentle west slope. Fairview Valley is 30 mi long with a floor sloping north from 5,500 feet at the south end to 3,900 feet in a playa at the north end. Fourmile Flat is an alkali flat and playa.—M.C.

**Schilling, John H.** *See* Beal, Laurence H. 1008

1308 **Schilling, John H.** Molybdenum resources of New Mexico: New Mexico Bur. Mines and Mineral Resources Bull. 76 p., illus., table, 1965.

Molybdenum minerals are widely distributed and 74 occurrences have been reported in 7 types of deposits: pegmatite dikes, 4; quartz veins, 30; porphyry-copper deposits, 6; copper-poor porphyry-molybenum deposits, 1; contact-tungsten deposits, 3; oxidized lead bodies, 17; and bedded uranium deposits, 3. The largest and only current molybdenum producer is the Santa Rita porphyry-copper mine, Grant County, from which over 32 million lbs of molybdenite have been recovered as a by-product. The second largest producer was the Questa mine, Taos County, where over 20 million lbs of molybdenite were mined from quartz veins, which are now mined out. An associated large, low-grade porphyry-molybdenum deposit is being readied for large-scale mining. Both areas have large reserves. The Grants uranium area is another potentially important source.—M.C.

**Schlanger, Seymour O.** *See* Hathaway, John C. 1327

**Schoellhamer, J. E.** *See* Yerkes, R. F. 1439

1417 **Schoen, Robert; White, Donald E.** Hydrothermal alteration in GS-3 and GS-4 drill holes, Main Terrace, Steamboat Springs, Nevada: Econ. Geology, v. 60, no. 7, p. 1411–1421, illus., 1965.

Predominant alteration shows zoning related to distance from fractures. Adjacent to fractures, illite (sericite), quartz, and pyrite replace all feldspars, chlorite, and mixed-layer illite-montmorillonite; the chlorite and illite-montmorillonite represent alteration of primary hornblende, biotite, and calcic plagioclase, farther from fractures. Less prominent changes, related to depth, include local replacement of calcic cores of plagioclase by albite or calcite at 200 feet or more, and by K-feldspar above 300 feet. The minerals are those that theoretically would be expected at the temperatures and water compositions in the drill holes, which suggests that present waters are producing the observed alteration, and resemble an ore-forming fluid.—W.S.W.

1198 **Schopf, J. M.; Ehlers, E. G.; Stiles, D. V.; Birle, J. D.** Fossil iron bacteria preserved in pyrite: Am. Philos. Soc. Proc., v. 109, no. 5, p. 288–308, illus., 1965.

Electron micrographs of the oxidized surface of a Middle Pennsylvanian pyrite specimen show three species of fossil iron bacteria with good resolution of

morphologic detail. The pyrite is part of a "sulfur ball" found on an abandoned mine dump in Vinton County, Ohio, from which the Middle Kittaning (No. 6) coal of the Allegheny Formation was formerly mined. The new species *Sphaerotilus catenulatus* and *Gallionella pyritica* closely resemble modern species of these genera. Affinity of a third form, with sharply defined segments, is uncertain; it may be allied to the Beggiatoales. A very similar microbiotic association is found in low-nutrient swamp environments today; the similarity seems to indicate that a remarkable geologic stability of both environment and organisms has existed for at least 300 million years.—V.M.J.

**Schreiber, Edward.** *See* Anderson, Orson L. 1205

1156 **Selig, Franz.** A theoretical prediction of salt dome patterns: Geophysics, v. 30, no. 4, p. 633–643, illus., tables, 1965.

Z. F. Dane's mathematical formulation of salt dome dynamics was modified to the extent that explicit solutions can be obtained. For both the two-dimensional and three-dimensional model, a formula is derived relating the rate of growth and the wavenumber of a fundamental mode with the physical and geometrical parameters. It is shown that there exists one wavenumber for which the rate of growth reaches a maximum. In time this component will dominate and control the final pattern.—Author's abstract

1386 **Sever, Charles W.** The Chattahoochee anticline in Georgia: Georgia Mineral Newsletter, v. 17, p. 39–43, illus., 1965.

Because of the many varying opinions about the nature of this structure, Sever reviews existing data on the structure and the history of its nomenclature in order to propose a change in concepts regarding its extent and trend, and to redefine and reintroduce the name Chattahoochee anticline. He considers the feature to be a northeast-southwest trending anticline cresting in Georgia in Dougherty, Mitchell, Baker, Miller, Early, and Seminole Counties where outcrops of upper Eocene rocks are completely surrounded by young Oligocene outcrops. Displacement across recognized faults indicates uplift relative to adjacent areas and the trend is determined by the elliptical shape of the outcrop areas. Movement causing upwarp probably occurred in Miocene time.—M.C.

1435 **Sharps, Thomas I.** Tungsten in Colorado: Colorado School Mines Mineral Industries Bull., v. 8, no. 5, 16 p., illus., tables, 1965.

Within this State are found both the oldest major producing districts in the Nation (Boulder County) and the newest major source of tungsten concentrates (Climax Molybdenum mine). Several other areas are known to contain tungsten-bearing minerals; these occurrences are described briefly. The production history is outlined, including legislative actions affecting the industry; and a selected bibliography has been appended.—G.D.C.

1089 **Shaw, A. B.** Paleontology in Mid-Continent exploration [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1564, 1965.

**Shawe, D. R.** *See* Brokaw, A. L. 1357

**Shell, H. R.** *See* Huggins, Charles W. 1323

1145 **Sheppard, Richard A.; Gude, Arthur J., 3d.** Potash feldspar of possible economic value in the Barstow Formation, San Bernardino County, California: U.S. Geol. Survey Circ. 500, 7 p., illus., table, 1965.

Tuffs in the Barstow Formation of Miocene age are altered mainly to zeolites, potash feldspar, montmorillonite, and a silica mineral. Potash feldspar is the major constituent of a conspicuous tuff, 1.5–4 feet thick, in the central part of the Mud Hills. This chemically analyzed feldspar-rich tuff shows a range of 12.4–16.4 percent $K_2O$. The very high potash feldspar content suggests that this deposit or others like it can become a source of feldspar for the glass and ceramic industries. Authors' abstract

1220 **Shurbet, D. H.** The pP phase generated in water covered areas: Seismol. Soc. America Bull., v. 55, no. 4, p. 721–726, illus., table, 1965.

The appearance of the pP phase, on seismograms, is strongly affected by the crustal structure in the vicinity of the epicenter. A recognizable pP phase is generated near the west coast of North America when the uppermost layer is water of sufficient depth. The generation of this pP is also affected by ocean bottom conditions. The bottom must probably be flat and the coefficient of reflection between the water and the bottom must be high. This pP phase may be useful in epicenter location and in crustal studies.—Author's abstract

1131 **Sikich, Steve W.** Upper Triassic stratigraphy in the eastern Uinta Mountains: Mtn. Geologist, v. 2, no. 3, p. 167–172, illus., 1965.

Suggestions are made regarding revision of nomenclature in the Triassic sequence in the eastern Uinta Mountains in Utah and Colorado. The name, Chinle Formation, should be applied to the medial conglomerate and overlying redbeds, with the conglomerate being termed the Gartra Member and the overlying redbeds the Stanaker Member of the Chinle Formation. The Gartra Member is chiefly poorly sorted, fine-grained to granular fluvial sandstone with varying amounts of pebbles with diameters up to 2 inches, the conglomeratic portion usually occurring as lenses. Thickness varies from less than 10 to 90 feet. Probable source areas are the Uncompahgre uplift and possibly the ancestral Rockies. The Stanaker Member is mostly silty to sandy shale with varying amounts of interbedded siltstone and sandstone and irregular thickness variations from 196 to 299 feet.—M.C.

**Simmons, George C.** *See* Weir, Gordon W. 1441

1369 **Simpson, Dale R.** Carbonate in hydroxylapatite: Science, v. 147, no. 3657, p. 501–502, tables, 1965.

Unit cell dimensions of hydroxylapatite synthesized hydrothermally are $a_o = 9.43_6$ A and $c_o = 6.88_5$ A. A deficiency of both calcium and phosphorus in the carbonate apatite suggests a coupled substitution of hydronium and carbonate ions in the structure.—Author's abstract

1238 **Simpson, George Gaylord.** A review of masterometry: Evolution, v. 19, no. 2, p. 249–255, 1965.

Masterometry is a new approach to study of carnivore evolution proposed by the Spanish paleontologist, M. Crusafont Pairô, in collaboration with J. Truyols Santonja. It appears to lend some evidence for the typology and orthogenesis theories but against "Neo-Darwinism" or the synthetic theory. One of their techniques is being used for the study of fossil carnivores. This paper reviews the techniques which are based on special studies on dentition of fissiped carnivores and which might be more widely used for other studies. The methods quantify adaptive characteristics formerly studied only qualitatively and are an excellent new descriptive tool for dealing simultaneously with large groups of species and genera. They also cast new light on the evolution of adaptation and on phylogeny in fissiped carnivores.—M.C.

1420 **Sinclair, A. J.** Oceanic lead isotopes and ore genesis: Econ. Geology, v. 60, no. 7, p. 1533–1539, illus., 1965.

The effects of various ore-forming processes (e.g. volcanism, sedimentation, metamorphism, rheomorphism, and hydrothermal activity) on isotopic composition of lead are reviewed from a theoretical standpoint.—W.S.W.

**Sloan, R. E.** *See* VanValen, L. 1345

**Smith, Jordan R.** *See* Lawson, Donald E. 1119

1027 **Snow, David Tunison.** A parallel plate model of fractured permeable media [abs.]: Dissert. Abs., v. 26, no. 2, p. 960–961, 1965.

1446 **Sohl, Norman F.** Marine Jurassic gastropods, central and southern Utah: U.S. Geol. Survey Prof. Paper 503-D, p. D1-D29, illus., tables, 1965.

This paper describes a gastropod fauna of 19 species assigned to 17 genera from the lower limy units of the Carmel Formation and from the Twelvemile Canyon Member of the Arapien Shale (Bajocian to Callovian) in central and southwestern Utah. . . .—Author's abstract

**Souther, J. G.** *See* Hutchison, W. W. 1211

1171 **Spencer, Edgar Winston.** Geology—A survey of earth science: New York, Thomas Y. Crowell Co., 673 p., illus., 1965.

This textbook is a nonmathematical introduction to geology and related earth sciences; it includes introductions to astronomy and meteorology in chapters which can be omitted for a one semester survey course in geology. Chapter topics discussed in detail include: oceans, matter, minerals and rocks, surface features of the Earth, structure and interior of the Earth, analysis of Earth history, sketches from geologic history, and history of life. Scientific terms have been italicized where they appear for the first time or where they are most fully defined and described. A series of shaded relief and geologic maps with sample questions at the end of the book, and a selected list of references are included.—G.D.C.

1344 **Spillers, James P.** Distribution of hydrocarbons in south Louisiana by types of traps and trends—Frio and younger sediments: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1749-1751, 1965.

Since Frio time, south Louisiana has been characterized by regressive sedimentation, southward thickening sedimentary units, increased sedimentation rate, and gradual retreat of the Gulf of Mexico. The depositional units include continental, transitional, and marine facies. Most hydrocarbon production is from sandstones in the transitional facies. Hydrocarbons in Frio and younger sediments are associated with six types of traps: salt domes; circular or elongate domes, probably having salt cores; anticlinal closures with growth faults; fault closures; closures on regional structural noses; and stratigraphic traps. The seven major producing trends recognized are: Frio, Anahuac, Lower Fleming, Middle Fleming, Upper Fleming I, Upper Fleming II, and Quaternary.

1253 **Stanley, Edward A.** Upper Cretaceous and Paleocene plant microfossils and Paleocene dinoflagellates and hystrichosphaerids from northwestern South Dakota: Bulls. Am. Paleontology, v. 49, no. 222, 384 p., illus., tables, 1965.

From palynological studies in four stratigraphic sections in Harding County 80 species of plant microfossils are assigned to 53 genera; 51 species and 3 genera are described as new. Among 19 species of dinoflagellates and hystrichosphaerids, 9 species are described as new. On the basis of plant microfossils, the Crow Butte section (Late Cretaceous) is divided into three zones; the North Cave Hills section (Paleocene) into two. The Twin Butte section, thought to contain the Cretaceous-Tertiary boundary, is shown to correlate with the North Cave Hills, and is entirely Paleocene, as is also the Cannonball section. From extant genera a temperate climate is postulated for Paleocene time.—G.D.C.

**Stearns, Charles E.** *See* Nichols, Robert L. 1084

1240 **Stebbins, G. Ledyard.** The probable growth habit of the earliest flowering plants: Missouri Bot. Garden Annals, v. 52, no. 3, p. 457-468, 1965.

Evidence is shown that the original angiosperms were woody shrubs or subshrubs rather than trees; from these, evolution in the form of adaptive radiation gave rise both to taller shrubs and trees and to herbs, including monocots. The relatively high degree of vascular specialization in herbs is regarded as a result of stronger selection pressure for this condition rather than as evidence that herbs are more recent in their evolution than are trees. Distribution patterns of many herbs suggest that they are very old; absence of herbs from the fossil record is regarded as the effect of bias in the record rather than as evidence that herbs did not exist during

earliest angiosperm evolution. In the Gruinales, Malvales, and Polygonaceae, genera containing shrubs are shown to have less specialized reproductive systems than related arboreal genera.—V.M.J.

1153 **Steen, Virginia C.; Fryxell, Roald.** Mazama and Glacier Peak pumice glass—Uniformity of refractive index after weathering: Science, v. 150, no. 3698, p. 878–880, illus., 1965.

Weathering has had little differential effect on modal values of the index of refraction of pumice glasses from the eruptions of Mount Mazama and Glacier Peak thousands of years ago. Confidence is thus increased that the ranges of values for the index of refraction are reliable characteristics by which the two glasses may be distinguished from one another.—Authors' abstract

1216 **Steenland, Nelson C.** Oil fields and aeromagnetic anomalies: Geophysics, v. 30, no. 5, p. 706–739, illus., 1965.

Six examples (from West Texas, Wyoming, the Dakotas, Alaska, and Libya) of relationships between aeromagnetic anomalies and producing areas are presented. Correlative magnetic anomalies exist in basement maps prepared both before and after discoveries; they would be disclosed by any competent technique, so interpretation techniques are not part of the argument. Three of the examples represent structures with associated intrabasement contrasts of magnetization, and the others are purely structural effects. There are difficulties in using either type of anomaly quantitatively for determination of basement depth or relief, but improvement of the definition of the observed aeromagnetic field, possible with the more sensitive new instrumentation, should bring out small residual structural effects.—D.B.V.

1272 **Stephens, F. H.** Mount Nansen properties near production target: Western Miner, v. 38, no. 9, p. 52–54, 1965.

Veins along faults at the Peso Silver Mines, Ltd., Yukon, contain gold and silver ore averaging 0.43 ounces of gold and 20 ounces of silver per ton.—A.R.K.

1273 **Stephens, F. H.** La Forma in production: Western Miner, v. 38, no. 9, p. 39–44, 1965.

The La Forma gold mine is on Mount Freegold in the Dawson Range, Yukon. Oldest rocks are Precambrian(?) gneiss and quartzite of the Yukon group. These are intruded by stocks of granodiorite, syenite porphyry, and granite of Jurassic age, and by mafic and felsic dikes. Ore contains 0.70 ounces of gold per ton.—A.R.K.

1274 **Stephens, F. H.** Western Mines, Ltd.: Western Miner, v. 38, no. 8, p. 37–42, 1965.

The ore deposit of this mine is in a shear zone in tuffs, agglomerates, and andesite flows. Lenticular ore bodies are a fine-grained massive aggregate of chalcopyrite, sphalerite, galena, and gangue, mainly in sericite schist. Some of the ore is banded. Ore averages 0.07 ounces gold, 2.52 ounces silver, 2.10 percent copper, 1.36 percent lead and 10.40 percent zinc and minor cadmium (including dilution factor of 20 percent).—A.R.K.

**Stephenson, D. A.** *See* Mifflin, M. D. 1140

**Stiles, D. V.** *See* Schopf, J. M. 1198

1280 **Stoner, Oscar E., Jr.** Oscar E. Stoner (1892–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1540–1541, portrait, 1965.

1213 **Strangway, David W.** Interpretation of the magnetic anomalies over some Precambrian dikes: Geophysics, v. 30, no. 5, p. 783–796, illus., 1965.

Some examples of the effect of remanent magnetization of rocks on magnetic fields are presented. The remanent magnetization and susceptibility were measured on a large number of samples collected from a series of dikes in Ontario and Quebec, and the expected curves for ground vertical component magnetic profiles and airborne magnetic curves were computed from these measurements and compared with observed profiles. Good correlation was found when both remanent and induced magnetization were considered. In determining intensity of remanent magnetization, samples with unusually high Q values were rejected as probably representing local effects due to lightning strikes; the mean value of magnetization was determined by taking into account the scatter of directions of measured NRM's.—D.B.V.

1196 **Stubican, V. S.; Roy, Rustum.** Mechanism of the precipitation of the spinel from $MgO$–$Al_2O_3$ solid solutions: Jour. Physics and Chemistry Solids, v. 26, no. 8, p. 1293–1297, illus., 1965.

The recently reported crystalline solubility of $Al_2O_3$ in MgO was confirmed. Unit cell dimensions and densities were measured independently and the existence of a predominant cation-vacancy model established for these crystalline solutions. The precipitation of the spinel was effected in the air at 1350° and 1100°C and studied by quantitative X-ray diffraction. The precipitation is a diffusion controlled process and the equation . . . fits the experimental results for $y=0.05$—$0.95$. The exponent $n$ was found to be very close to 3/2, suggesting that under the experimental conditions the growing particles were approximately spheroidal. Electron probe investigations showed that the preferred sites for the nucleation and the precipitation of spinel were the grain boundaries and intergranular voids.—Author's abstract

1384 **Stuckey, Jasper Leonidas.** North Carolina—Its geology and mineral resources: Raleigh, N. C., North Carolina Dept. Conserv. and Devel., 550 p., illus., tables, 1965.

Few areas of equal size in the United States are endowed with as great a variety of rocks, minerals and geologic phenomena as that of North Carolina. In the mountainous section are Precambrian metamorphic rocks, among the oldest rocks in the United States. In the Piedmont are various types of rocks of Paleozoic and Mesozoic ages, and the Coastal Plain is underlain by a varying thickness of sedimentary rocks that are Cretaceous, Tertiary, and Quaternary in age. The geology and history of all these, and more than 300 varieties of minerals and rocks are described. A history is given also of the mining activities, and of the development of geologic research.—G.D.C.

1166 **Stumm, Erwin C.** Two unusually well-preserved rugose corals from the Jeffersonville Limestone (Devonian) of the Falls of the Ohio: Michigan Univ. Mus. Paleontology Contr., v. 19, no. 12, p. 157–161, illus., 1965.

Unusually well-preserved specimens of *Heterophrentis inflata* (Hall) and *Scenophyllum conigerum* (Rominger) are described and illustrated, the calyx views by stereophotographs. Both specimens are from the Middle Devonian Jeffersonville Limestone, Falls of the Ohio River, Jeffersonville, Ind.—V.M.J.

1333 **Suffel, G. G.** Remarks on some sulphide deposits in volcanic intrusives: Canadian Mining and Metall. Bull., v. 58, no. 642, p. 1057–1063, 1965.

Suffel compares deposits in Cyprus, which he believes are volcanic-exhalative-sedimentary in origin and formed in the closing stages of volcanism, with those of Turkey and Canada. Deposits in Turkey are in much the same eugeosynclinal environment as those in Cyprus. Some Canadian deposits are also of this type; other similar deposits in Canada may have a different origin or have been metamorphosed.—A.R.K.

1331 **Summers, W. K.** Geology and ground-water resources of Waushara County, Wisconsin: U.S. Geol. Survey Water-Supply Paper 1809-B, p. B1–B32, illus., tables, geol. map, 1965.

Abundant ground water for irrigation is available in the outwash deposits in western Waushara County, and many more large-capacity wells can be developed in these deposits without seriously lowering the water level. Large supplies are available for irrigation from extensive sand and gravel deposits in the western part of the county; moderate supplies are available from sand, gravel, and sandstone in the eastern part. Quality is good except for hardness and local high concentrations of iron. Selected water analyses and surficial geology and bedrock and water table contour maps are included.—W.L.G.

**Sunagawa, Ichiro.** *See* Komatsu, Hiroshi. 1320

**Susuki, Takeo.** *See* Carlisle, Donald. 1336

1164 **Sutton, R. G.; Rukavina, N. A.; Towle, E. L.** Changes in the level of Lake Ontario as inferred from offshore sediments at Braddock Heights, New York: Rochester Acad. Sci. Proc., v. 11, no. 2, p. 72–82, illus., 1965.

The results of an exploratory survey, made in this area to provide information for a shoal development program, are summarized. Two types of sediments on the nearshore bottom could be identified, one at depths less than 25 feet was remarkably uniform, the other at greater depths was highly variable. The boundary coincides with a steepening of the bottom slope, and the sorting shifts with summer and winter waves and currents. Two boulder areas at depths of 30–40 feet appear to be sites of eroded drumlins, which may have flanked a bay indicated by a zone of organic material in core samples. A rise in water level of 25 to 30 feet would explain the observations to date.—G.D.C.

1022 **Sweet, Arnold Lawrence.** A stochastic model for predicting the subsidence of granular media [abs.]: Dissert. Abs., v. 26, no. 2, p. 923, 1965.

1049 **Swingle, George D.** Geologic map of the Morgan Springs quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 110-SE [sheet 1], scale 1:24,000, section, separate text, 1963 [1964].

The text, "Mineral resources summary of the Morgan Springs quadrangle, Tennessee," by E. T. Luther and G. D. Swingle (1964) is cited separately.—M.C.M.

**Swingle, George D.** *See* Luther, Edward T. 1052

**Swingle, George D.** *See* Luther, Edward T. 1053

1054 **Swingle, George D.** Geologic map of the Pennine quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 118-NW [sheet 1], scale 1:24,000, section, separate text, 1964.

The text, "Mineral resources of the Pennine quadrangle, Tennessee," by E. T. Luther and G. D. Swingle (1964) is cited separately.—M.C.M.

1356 **Sykes, Lynn R.; Ewing, Maurice.** The seismicity of the Caribbean region: Jour. Geophys. Research, v. 70, no. 20, p. 5065–5074, illus., table, 1965.

The hypocenters of about 500 Caribbean earthquakes have been relocated with an accuracy of about 10 km, using a digital computer. Their spatial distribution is used here to study in detail the tectonics of deep-sea trenches, fault zones, and island arcs of the region, including northern South America. The distribution of earthquake focuses, tectonic provinces, and the Puerto Rico Trench are examined.—D.B.V.

**Tanguy, D. R.** *See* Tixier, M. P. 1193

1258 **Tatsumoto, M.; Hedge, C. E.; Engel, A. E. J.** Potassium, rubidium, strontium, thorium, uranium, and the ratio of strontium-87 to strontium-86 in oceanic tholeiitic basalt: Science, v. 150, no. 3698, p. 886–888, illus., 1965.

The average concentrations of potassium, rubidium, strontium, thorium, and uranium in oceanic tholeiitic basalt are (in parts per million) K, 1400; Rb, 1.2; Sr, 120; Th, 0.2; and U, 0.1. The ratio of Sr-87 to Sr-86 is about 0.702, that of K to U is $1.4\times10^4$, and of Th to U is 1.8. These amounts of K, Th, U, and radiogenic Sr-87 are less than in other common igneous rocks. The ratios of Th to U and Sr-87 to Sr-86 suggest that the source region of the oceanic tholeiite was differentiated from the original mantle material some time in the geologic past.—Authors' abstract

1120 **Tenney, Charles S.** Permo-Pennsylvanian deposition in Wyoming [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1572, 1965.

**Tetreault, Diane.** *See* Maxwell, J. A. 1431

**Thomas, Gilbert.** *See* Alliger, Jerald. 1105

1029 **Thompson, Erik Grinde.** An experimental technique for the investigation of the flow of halite and sylvinite [abs.]: Dissert. Abs., v. 26, no. 2, p. 971, 1965.

1330 **Thompson, Gerald L.** Hydrology of melt-water channels in southwestern Minnesota: U.S. Geol. Survey Water-Supply Paper 1809-K, p. K1-K11, illus., table, geol. map, 1965.

Melt-water channel deposits are among the most important aquifers in southwestern Minnesota, but permeable zones within the deposits are difficult to locate. Interpretation of the depositional history of proglacial channel deposits from aerial photographs and test-hole samples indicates the position of the permeable zones. Generally, the coarse-grained deposits are in headwater areas, near the confluence of two channels, in bends, or at the junction of sluiceways. Locally, these deposits yield as much as 1,000 gpm to wells.—Author's abstract

1165 **Thomson, R.** Geology of Casey and Harris townships, District of Timiskaming: Ontario Dept. Mines Geol. Rept. 36, 77 p., illus., tables, geol. map, 1965.

The townships, on Lake Timiskaming about 20 mi northeast of Cobalt, are included in the Timiskaming silver-cobalt area, which has only one producer, the Langis mine. The Precambrian bedrock sequence of Keewatin metavolcanics and metasediments is cut by Algoman intrusives and overlain by the Cobalt Group of sedimentary rocks, which, in turn, are intruded by a Nipissing diabase sill. Overlying the Precambrian unconformably are Paleozoic rocks consisting of Ordovician and Silurian sedimentaries, which, in turn, are overlain unconformably by the Cenozoic sediments. A drill hole in the area of a magnetic anomaly shown on early magnetic survey map sheets, revealed an iron-bearing formation in the Keewatin rocks. Some construction materials are present. Silver-cobalt deposits at Langis mine occur in veins in the Cobalt Group and Nipissing diabase.—M.C.

1193 **Tixier, M. P.; Eaton, F. M.; Tanguy, D. R.; Biggs, W. P.** Automatic log computation at well-site-Formation analysis logs, *in* SPWLA Logging Symposium, 6th Ann., Dallas, Tex., 1965, Trans., V. 1: Houston, Tex., Soc. Prof. Well Log Analysts, p. B1-B18, illus., 1965.

New logs and greater flexibility in electrical well-logging applications are now provided by truck-mounted computer systems. These special computers digitize and record on tape the data from well surveys. Simultaneously with the recording of a subsequent log, the computers merge taped data and perform continuous log analysis computation. The optical recordings of these computations provide a rapid means of formation evaluation in the field. A major application of the truck-mounted systems has been the merging of data from an induction-electrical survey with that from either a sonic or a formation density log. The resulting formation analysis log consists of continuous curves of $R_{wa}$, $F_R/F_S$ (or $F_R/F_D$), and apparent porosity. The location of potential pay zones is more easily and quickly accomplished by scanning these computed logs than by manually performing the computations.—J.W.C.

**Tomilson, Margaret E.** *See* Maxwell, J. A. 1431

**Towle, E. L.** *See* Suton, R. G. 1164

**Treadwell, R. C.** *See* Holden, R. N. 1359

**Treitel, S.** *See* Robinson, E. A. 1225

1389 **Troell, Arthur Richard.** Sedimentary facies of the Toronto Limestone, lower limestone member of the Oread megacyclothem (Virgilian) of Kansas [abs.]: Houston Geol. Soc. Bull., v. 8, no. 3, p. 20–21, 1965.

1423 **Turner, G.** Extinct iodine 129 and trace elements in chondrites: Jour. Geophys. Research, v. 70, no. 21, p. 5433–5445, illus., tables, 1965.

I–Xe formation intervals for the Bjurböle chondrite and the dark and light fractions of the Pantar meteorite, measured by activation techniques with the correlated release method, are 60±2, 68±3, and 60±8 m.y. On the basis of the uniform synthesis model, the similarity of these and other recently measured values increases confidence in the validity of the method. Other models of nucleosynthesis are considered. Current ideas on the formation of the gas-rich meteorites are considered in the light of the strong depletion in I, Te, and Br found in the light fraction of Pantar with respect to both the dark fraction and ordinary chondrites.—D.B.V.

**Turner, M. D.** *See* Dort, Wakefield, Jr. 1256

1021 **Tuttle, Russell Howard.** A study of the chimpanzee hand with comments on hominoid evolution [abs.]: Dissert. Abs., v. 26, no. 2, p. 619, 1965.

**Udintsev, Gleb B.** *See* Lubimova, Elena A. 1000

1175 **Upton, B. G. J.** The geology of Tugtutôq and neighboring islands, South Greenland—Pt. 4, The nepheline syenites of the Hviddal composite dyke: Grønlands Geol. Undersøgelse Bull. 48, p. 50–80, illus., tables, reprinted 1964.

This was originally published in Medd. om Grønland, v. 169, no. 3, 1964.—M.C.M.

1176 **Upton, B. G. J.** The geology of Tugtutôq and neighboring islands, South Greenland—Pt. 3, Olivine gabbros, syeno-gabbros and anorthosites: Grønlands Geol. Undersøgelse Bull. 48, p. 3–47, illus., tables, geol. maps, reprinted 1964.

This was originally published in Medd. om Gronland, v. 169, no. 3, 1964.—M.C.M.

1177 **Upton, B. G. J.** The geology of Tugtutôq and neighboring islands, South Greenland—Pt. 2, Nordmarkitic syenites and related alkaline rocks: Grønlands Geol. Undersøgelse Bull. 44, 62 p., illus., geol. maps, reprinted 1964.

This was originally published in Medd. om Gronland, v. 169, no. 2, 1964.—M.C.M.

**Uyeda, Seiya.** *See* Lee, William H. K. 1001

1361 **Valerius, R. D.** Frio cross section, D–D′: Corpus Christi, Tex., Corpus Christi Geol. Soc., 1964.

1172 **Vand, Vladimir.** Astrogeology—Terrestrial meteoritic craters and the origin of tektites, *in* Advances in geophysics, V. 11: New York, Academic Press, p. 1–114, illus., tables, 1965.

The author reviews in detail the geographic distribution, chemical composition, ages, physical properties, and varieties of tektites and the related silica glasses and impactites. Descriptions are included of meteoritic craters associated with tektites. In the section on the origin of tektites, the following theories are discussed: terrestrial and lunar volcanism, terrestrial lightning, searing of soil by heat from a grazing meteorite, remains of Earth–Moon separation, terrestrial meteoritic and comet impacts, lunar meteorite impact, Earth's satellites in circular orbit, general

meteoritic theories, and backsplash hypothesis. Vand considers the terrestrial origin of tektites as the most likely. A bibliography includes 410 papers.—M.C.

1288 **VanLandingham, Sam L.** Diatoms from Mammoth Cave, Kentucky [with German summary]: Internat. Jour. Speleology, v. 1, pt. 4, p. 517–539, illus., tables, 1965.

Samples collected here have revealed the presence of a diversified but not too abundant diatom community in this cave. As the material was not subjected to culturing experiments but was investigated immediately after arrival, both in native and permanent preparations, it was possible to ascertain that the majority of the diatoms contained well developed, apparently healthy and functioning chloroplasts, and to get a rough estimate of the actual number of specimens present in a microhabitat. On the basis of its peculiarities the autochthonous diatom community seems to be a derivative of a more ancient type of vegetation which has been in the cave since near the time of its formation. The geological and environmental conditions are described.—G.D.C.

1345 **VanValen, L.; Sloan, R. E.** The earliest Primates: Science, v. 150, no. 3697, p. 743–745, illus., table, 1965.

The known range of the Primates is extended down from the middle Paleocene to the early Paleocene and Late Cretaceous by a new genus and two new species from Montana, *Purgatorius unio* and *P. ceratops*. These species approach condylarths and leptictid and erinaceoid insectivores in structure. *Purgatorius* is referred to a new subfamily, Purgatoriinae, of the Paromomyidae, but is probably not the stem primate. The fauna of Purgatory Hill indicates a late early Paleocene age.—Authors' abstract

1261 **VanValen, Leigh.** Treeshrews, primates, and fossils: Evolution, v. 19, no. 2, p. 117–151, illus., tables, 1965.

Early studies showed a close relationship between Tupaiidae and Primates, the main contribution being Simpson's 1931 referral of the Oligocene genus *Anagale* to the Tupaioidea. More recent studies show that *Anagale* is not a tupaioid, but the Paleocene genus *Adapisoriculus* is a tupaiid that is not particularly similar to Paleocene primates. Restudy of evidence of tupaiid–primate affinities, especially that based on basicranial and orbital regions of the skull, indicates that a special tupaiid–primate relationship is possible but unlikely and that similarities between Recent tupaiids and primates probably are convergences and primitive retentions. Advocates of polyphyletic taxa refer Tupaiidae to Primates but, based on the view of separate ancestry, the author prefers to refer them to Insectivora.—M.C.

**Vaz, J. E.** *See* Dort, Wakefield, Jr. 1256

**Vecchioli, J.** *See* Gill, H. E. 1314

**Vedder, J. G.** *See* Yerkes, R. F. 1439

**Vincent, H. A.** *See* Volborth, A. 0995

1182 **Vine, F. J.; Wilson, J. Tuzo.** Magnetic anomalies over a young oceanic ridge off Vancouver Island: Science, v. 150, no. 3695, p. 485–489, illus., 1965.

The recent speculation that the magnetic anomalies observed over oceanic ridges might be explained in terms of ocean-floor spreading and periodic reversals of the Earth's magnetic field may now be reexamined in the light of suggested reversals during the past 4 million years and the newly described Juan de Fuca Ridge. Authors' abstract

1403 **Viswanathan, K.; Ghose, Subrata.** The effect of $Mg^{2+}$–$Fe^{2+}$ substitution on the cell dimensions of cummingtonites: Am. Mineralogist, v. 50, nos. 7–8, p. 1106–1112, illus., tables, 1965.

Values of $2\theta$ of 12 reflections and cell dimensions for 21 chemically analyzed cummingtonites (Mueller, 1960) from a metamorphosed iron formation of east

central Quebec are given. Linear determinative plots and their equations are given for d(061), a, a sin$\beta$, b and c vs. $Mg^{2+}/(Mg^{2+}+Fe^{2+})$ from 0.0197 to 0.622. With increasing $Mg^{2+}$, cell dimension b shows the maximum increase, which is attributed to expansion of the octahedral layer. Coefficients of expansion due to $Mg^{2+}$–$Fe^{2+}$ substitution in cummingtonite are similar to those of a, b and c in orthopyroxenes, and of b in clinopyroxenes.—B.C.H.

**Volborth, A.** *See* Weyler, P. A. 0994

0995 **Volborth, A.; Vincent, H. A.; Weyler, P. A.** Trace elements in Shoal granite samples, *in* Geological, geophysical, chemical, and hydrological investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 214–237, illus., tables, 1964 [1965].

Thirty-four samples of granite obtained at approximately 50-ft intervals from drill hole ECH-D in Sand Springs Range were analyzed for trace elements using X-ray emission spectroscopy. The spectrographic and flame spectrophotometric methods were used for analyses for lithium, boron, and beryllium. Elements not detected included molybdenum, silver, antimony, cesium, and mercury. Based on calibration curves, samarium and hafnium were not detected but were reported on the basis of energy distribution curves.—M.C.

1202 **Volk, H. W., Jr.** West Cosden (Hockley) Field, Bee County, Texas: South Texas Geol. Soc. Bull., v. 5, no. 14, p. 9–18, illus., 1965.

This small field is separated from the Dirks (Pettus Sand) field by an up-to-the-coast fault. It is typical of the shallow field that most independent geologists and small operators are seeking, and is referred to as a hidden graben, in as much as at least nine wells were drilled through the entire Hockley series within its producing confines prior to its discovery in 1954. This was in part due to incorrect log interpretation, but also to the narrow, elongate shape of the producing area, making it a difficult target. In the stratigraphic succession no sands of the Jackson Group other than those of the Hockley Formation are found. The structure is discussed in detail, and a type log and production statistics are given.—G.D.C.

**VonHerzen, Richard P.** *See* Lubimova, Elena A. 1000

1322 **Wada, Koji.** Intercalation of water in kaolin minerals: Am. Mineralogist, v. 50, nos. 7–8, p. 924–941, illus., tables, 1965.

Intercalation of the kaolin minerals by $H_2O$ after intercalation by $KCH_3COO$ shows that halloysite forms a $H_2O$ complex with 10.1A basal spacing; nacrite forms a $H_2O$ complex with 8.35A basal spacing; kaolinite forms only a partial complex; and dickite none. The frequency of OH bending vibration of $H_2O$ molecule and the peak dehydration temperature for halloysite and nacrite are: 1627 $cm^{-1}$, 1655 $cm^{-1}$; 100–120°C, 200–210°C, respectively. The differences in behavior are explained by models of layer-stacking sequences in which molecular $H_2O$ is packed into the hexagonal cavities among basal oxygens.—E.Z.

1252 **Wagner, Marion B.** Wagner, Carroll M. (1893–1965): Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1541, portrait, 1965.

1268 **Wahl, Kenneth D.** Ground water in the vicinity of Bryce State Hospital, Negro Colony, Tuscaloosa County, Alabama: Alabama Geol. Survey Circ. 25, 38 p., illus., tables, 1965.

Ground water in the Bryce Negro Colony area occurs in three geologic units, from oldest to youngest, the Pottsville Formation of Pennsylvanian age, the Coker Formation of Late Cretaceous age, and the alluvial and terrace deposits of Quaternary age. Wells produce water from the latter two. All water in the area contains iron, which creates problems. Lithologic, drill-time, and electric logs and sample descriptions are given for 13 test wells drilled in 1962. Additional ground water can be best developed by a well in the center of the area. Pumpage of 50,000

gpd for a year from such a well would not lower the water level more than 0.1 ft at a distance of 5,000 feet.—M.C.

1341 **Wait, R. L.; Callahan, J. T.** Relations of fresh and salty ground water along the southeastern U.S. Atlantic Coast: Ground Water, v. 3, no. 4, p. 3–17, illus., 1965.

On the sandy coastal islands of North Carolina, fresh-water lenses under water-table conditions float on salt water. They may become salty by lateral encroachment from the ocean and bay, by vertical encroachment from below, by overland inundation during storms, and by downward percolation of spray and salty precipitation. In the Savannah, Ga., and South Carolina area, salt water encroachment along two of five zones in the principal artesian aquifer has been caused by pumping. Southward into Florida, connate salty water occurs in the artesian aquifer below fresh water; at Brunswick, Ga., it is stratified between fresh-water bodies in the limestone aquifer above 2,000 ft depths. Along the southeast Florida coast drainage canals have been the primary cause of contamination of the Biscayne aquifer.—G.D.C.

**Wanless, R. K.** *See* Larochelle, A. 1137

1095 **Ward, L. O.** Mississippian Osage, northwest Oklahoma platform [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1562–1563, 1965.

1440 **Waring, Gerald A.** Thermal springs of the United States and other countries of the world—A summary; revised by R. R. Blankenship and Ray Bentall: U.S. Geol. Survey Prof. Paper 492, 383 p., illus., tables, geol. maps, 1965.

Thermal springs are widely distributed throughout the world but are most numerous in areas in which there has been volcanic activity in late geologic time. A review of the literature has revealed much information on the location of the springs, the temperature of the water, the rate of flow, the chemical character of the water and evolved gases, and the uses made of the water. All such information has been tabulated by countries or geographic areas and is presented in the first part of this report. . . . The second part of the report consists of a list of references [3,733], some annotated briefly, to the literature on thermal springs. . . .—Author's abstract

**Warman, James C.** *See* Dodson, Chester L. 1251

1444 **Warren, H. V.; Delavault, R. E.** Further studies of the biogeochemistry of molybdenum: Western Miner, v. 38, no. 10, p. 64–72, 1965.

Vegetation at a number of ore deposits (mainly copper) in British Columbia were tested for molybdenum in ash. This year's and last year's growth of trees and lesser plants are shown to contain abnormal amounts of molybdenum in the vicinity of ore. Molybdenum can be used as a "pathfinder" for copper and some other metals, but not for lead and zinc deposits, which contain little molybdenum. Two case histories are described.—A.R.K.

1432 **Washington, R. A.** Construction and calibration of an apparatus for the measurement of surface areas of powdered samples: Canada Geol. Survey Paper 64–49, 13 p., illus., tables, 1965.

In experiments to measure the amount of trace elements adsorbed by silicate minerals, a technique was developed to determine the specific surface area of the adsorbents. The surface area is measured by determining the work done in withdrawing a liquid from a bed of the powdered sample, which must be wetted by the liquid, against surface tension forces. By using a series of standard samples of known specific surface area, a calibration curve can be obtained for the apparatus, which can be applied to any sample in the appropriate size range. One great advantage of the method is that it can be applied to particles of any shape in the size range from 0.72 mm diameter (20 mesh) to 0.068 mm diameter (250 mesh). With simple precautions in calibration, an accuracy of about ±5 percent is possible.—M.C.

**Wasson, B. E.** *See* Harvey, E. J. 1267

1195 **Watson, R. K.** Geophysicists hold new key for Pine Point ore: Northern Miner, v. 51, no. 22, p. 21, illus., 1965.

To find the best geophysical method to detect lead–zinc mineralization in the Pine Point area, self–potential, electromagnetic, and induced polarization methods were tested in 1963 over the biggest known orebody. Results of the induced polarization test, using Huntec equipment, were most successful. The Presqu'ile Formation, where barren of sulfides, yields a very smooth background, and anomalies over lead–zinc deposits range from 35 down to 2.5 or 3.0 msec. The low anomalies include some deep low–grade deposits large enough to be orebodies. The terrain of the Pine Point area is flat and swampy with alternating raised beaches which transverse the reef structure. Where this method was used at Sulphur Bay the background is less smooth.—G.D.C.

1294 **Weaver, O. D.** North flank of Appalachian set for testing, Pt. 1: Oil and Gas Jour., v. 63, no. 36, p. 216–219, illus., 1965; New York offers multiple strat–trap potential in Cambro–Ordovician sediments, Pt. 2: ibid., no. 37, p. 166–170, illus., 1965.

The sequence, distribution, and producing potential of the Cambro–Ordovician sediment wedge which outcrops across the shallow north flank of the Appalachian basin in northwestern and central New York are described. General stratigraphic relations and oil potential are discussed in part 1. Part 2 contains detailed subsurface cross–sections of the Cambro–Ordovician section in New York with outcrop data in the Adirondack Mountains. Numerous stratigraphic traps are indicated across this north Appalachian trend. Six basic stratigraphic conditions for production on a regional basis are illustrated and discussed.—V.S.N.

1326 **Weber, Jon N.; Roy, Rustum.** Dehydroxylation of kaolinite, dickite, and halloysite—Heats of reaction and kinetics of dehydration at $(PH_2O) = 15$ psi: Am. Mineralogist, v. 50, nos. 7–8, p. 1038–1045, illus., tables, 1965.

Values of the enthalpy of dehydration determined by differential thermal analysis are 151, 156 and 160 cal/gm for kaolinite, dickite and halloysite respectively. Activation energies for dehydration at a water pressure of 15 psi are considerably greater than published activation energies determined at much lower water vapor pressures. Kinetic data obtained from the DTA curves suggest that the order of reaction for the dehydration of kaolinite, dickite and halloysite is somewhat greater than one.—Authors' abstract

1041 **Webers, Gerald Frank.** A study of the Middle and Upper Ordovician conodont faunas of Minnesota [abs.]: Dissert. Abs., v. 26, no. 2, p. 987, 1965.

**Weed, E. G. A.** *See* Corwin, Gilbert. 1347

1236 **Weeks, L. G.** World offshore petroleum resources: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1680–1693, tables, 1965.

Offshore basins out to 1,000 feet water depth comprise 25 percent of the world's sedimentary basin area and 57 percent of the shelf area. A class A basin contains, or is in continuity with, an excellent producing area and has like geology; class B relates to a fair producing area or to similar geology; and class C is submarginal. The ultimate yield of petroleum liquids by primary recovery from class A and B offshore basins should be 700 billion bbl. All continental shelf areas are classified, rated as to estimated petroleum potential, and tabulated by 10 major world subdivisions. Current world offshore activities are reviewed.—B.H.K.

1110 **Weimer, Robert J.** Patrick Draw field, Sweetwater County, Wyoming—An old stratigraphic trap [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1574–1575, 1965.

1382 **Weir, Gordon W.; Greene, Robert C.** Clays Ferry Formation (Ordovician)—A new map unit in south-central Kentucky: U.S. Geol. Survey Bull. 1224-B, p. B1-B18, illus., tables, 1965.

The Clays Ferry Formation is a newly recognized major rock-stratigraphic unit in south-central Kentucky. It consists of interstratified thin-bedded shale, limestone, and siltstone; ranges from about 120 to 220 feet in thickness; is of late Middle and early Late Ordovician age; and overlies and intertongues with thick bedded limestone of the Lexington Limestone and grades into the overlying Garrard Siltstone.—W.L.G.

1441 **Weir, Gordon W.; Greene, Robert C.; Simmons, George C.** Calloway Creek Limestone and Ashlock and Drakes Formations (Upper Ordovician) in south-central Kentucky: U.S. Geol. Survey Bull. 1224-D, p. D1-D36, illus., 1965.

Upper Ordovician rocks in south-central Kentucky are divided into lithologically distinct formations chiefly on the basis of contrasts in their mudstone and limestone content. Three newly defined map units from the top of the Gerrard Siltstone to the top of the Ordovician, are described in this report. In ascending order, these are the Calloway Creek Limestone (limestone and minor shale), the Ashlock Formation (dolomitic mudstone and limestone), and the Drakes Formation (chiefly mudstone). Measured sections are given for each.—W.L.G.

1139 **Weld, Betsy A.; Griffin, Margaret S.; Brett, George W.** Reports and maps of the Geological Survey released only in the open files, 1964: U.S. Geol. Survey Circ. 498, 16 p. [1965].

This circular contains a list of maps and reports released by the U.S. Geological Survey during 1964 that are available for public inspection in the open files.—W.L.G.

1116 **Weldon, John P.** Dillinger Ranch field, Campbell County, Wyoming [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1573, 1965.

0994 **Weyler, P. A.; Volborth, A.** X-ray spectrographic analysis of major elements for granite from drill hole ECH-D, *in* Geological, geophysical, . . . investigations of the Sand Springs Range, Fairview Valley, and Fourmile Flat, Churchill County, Nevada: U.S. Atomic Energy Comm. Rept. VUF-1001, p. 203-213, illus., tables, 1964 [1965].

Samples of granite obtained at approximately 50-ft intervals from a drill hole in Sand Springs Range were analyzed for silica, alumina, iron, potassium, calcium, titanium, and manganese by X-ray spectrographic methods. Thirty-four samples were analyzed. The major elements studied appeared in every sample and the precision of results obtained was as good as with chemical methods, with the added advantages of speed, simplicity, and a non-destructive technique.—M.C.

**Weyler, P. A.** *See* Volborth, A. 0995

1237 **Wheeler, Harry E.** Ozark Pre-Cambrian-Paleozoic relations: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 10, p. 1647-1665, illus., 1965.

St. Francois Mts. previously believed to be an exhumed Precambrian range consisting of felsite are actually remnants of a regional thrust sheet, or sheets; other bodies of igneous rocks scattered over Missouri, Kansas, Oklahoma, Illinois and Kentucky also may be remnants of sheets thrust northward onto the craton from the Ouachita geosynclinal belt during latest Permian and/or later. Evidence includes discordant topographic expression of related igneous and sedimentary rocks, lack of contact metamorphism, cataclastic beds and siliceous detritus, local anomalous structures indicating north-south compression, mineralization associated with the Ozark dome, Precambrian igneous rock isotope ages. Possible klippen are felsite porphyry while basement rock is granite. This regional structure is named the St. Francois Thrust.—S.P.S.

**White, Donald E.** *See* Schoen, Robert. 1417

1085 **White, Walter S.** Bauxite deposits of the Warm Springs district, Meriwether County, Georgia: U.S. Geol. Survey Bull. 1199-I, p. I1–I15, illus., geol. maps, 1965.

Veinlike bodies of bauxite are present in the upper clay unit of unconsolidated sand and clay of probable Cretaceous age about 3 miles west of Warm Springs, Ga. These sediments overlie crystalline schists, gneisses, and quartzites of the Piedmont province, and the largest deposits lie in a trough faulted down against the crystalline rocks at the south. Bauxite was mined in the district from 1916 to 1919, and a total of 4,000 long tons was shipped.—W.L.G.

1045 **Whittles, Arthur Brice Leroy.** Trace lead isotope studies with gas source mass spectrometry [abs.]: Dissert. Abs., v. 26, no. 2, p. 989, 1965.

**Williams, Howel.** *See* McBirney, Alexander R. 1224

1290 **Wilson, Charles W., Jr.; Colvin, John M., Jr.; Lounsbury, Richard E.** Geologic map of the Littlelot quadrangle, Tennessee: Tennessee Div. Geology Geol. Map GM 49–SE, scale 1:24,000, separate text, 1964 [1965].

The accompanying text, "Mineral resources summary of the Littlelot quadrangle, Tennessee," by J. M. Colvin, Jr., is cited separately.—M.C.M.

**Wilson, Charles W., Jr.** *See* Moore, Gerald K. 1399

**Wilson, J. Tuzo.** *See* Vine, F. J. 1182

1257 **Wilson, J. Tuzo.** Transform faults, oceanic ridges, and magnetic anomalies southwest of Vancouver Island: Science, v. 150, no. 3695, p. 482–485, illus., 1965.

The San Andreas Fault and a large fault off British Columbia are interpreted as examples of recently proposed "transform faults." They are joined by a short, isolated length of oceanic ridge striking N. 20° E., with an associated "window" of young crust. The displacement along these faults is estimated at 400 kilometers.—Author's abstract

1368 **Wilson, J. Tuzo; Clarke, D. B.** Geological expedition to Capes Dyer and Searle, Baffin Island, Canada: Nature, v. 205, no. 4969, p. 349–350, 1965.

In the summer of 1964 a field party flew to Baffin Island to search for fossiliferous strata, map stratigraphy and geologic structures of the coastline, and collect oriented samples of lavas for paleomagnetic examination and age determinations. After a week spent in examining lavas on top of cliffs at Cape Dyer, the party flew to Broughton Island, 30 miles north of Cape Searle, and traveled south along the coast in Eskimo whaleboats. The possibility of correlating the lava flows and associated sediments with those on the Atlantic coasts of Scotland and East and West Greenland is of great significance in view of continental drift and Wilson's corollary suggestion (1963) that a branch of the North Atlantic Ridge should extend up the center of Baffin Bay.—D.B.V.

1088 **Wilson, L. R.** Palynological evidence for folding, faulting, and erosional contacts in subsurface [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1564, 1965.

1306 **Wilson, William H.** A field guide to the rocks and minerals of Wyoming: Wyoming Geol. Survey Bull. 51, 72 p., illus., tables, 1965.

This elementary guide, primarily for high school students and amateur collectors with little geological training, includes the following sections: physical properties and tests of minerals and collecting equipment; a summary of the geology of Wyoming with a stratigraphic table; descriptions and occurrences of about 67 minerals from agate to zircon; mineral table arranged in order of increasing hardness with notes on color and distinguishing features; and definitions, descriptions, and

occurrences of igneous rocks, granite–granodiorites, sedimentary rocks, petrified wood, metamorphic rocks, and meteorites. A list of ten useful references and a glossary of 46 geologic terms are appended.—M.C.

1065 **Wittry, Warren L.** The Institute digs a mastodon: Cranbrook Inst. Sci. News Letter, v. 35, no. 2, p. 14–19, illus., 1965.

On a farm in Lapeer County, Mich., Gotlieb Rappuhn's plow struck the jawbone of a mastodon, an old male, whose bones lay in a somewhat scattered but related position, on top of till buried by peat, in a glacial kettle hole. Bones of the feet were widely scattered, and many bones were charred and cut with knife marks, indicating, along with an assortment of cut poles and sticks, the Rappuhn mastodon's association with man.—G.D.C.

**Wood, E. J. Ferguson.** *See* Oppenheimer, Carl H. 1222

1042 **Wood, John William.** Geology of Apache Mountains, trans–Pecos Texas [abs.]: Dissert. Abs., v. 26, no. 2, p. 987–988, 1965.

1097 **Wright, B. J.** Lyons West field, Rice County, Kansas [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1562, 1965.

1161 **Wyllie, P. J.; Haas, J. L., Jr.** The system $CaO$–$SiO_2$–$CO_2$–$H_2O$—[Pt.] 1, Melting relationships with excess vapor at 1 kilobar pressure: Geochim. et Cosmochim. Acta, v. 29, no. 8, p. 871–892, illus., table, 1965.

Solid–liquid–vapor phase equilibria have been determined for points of the above system by delineating the phase fields intersected by the composition joia $CaCO_3$–$Ca(OH)_2$–($SiO_2$+4.3 wt percent $H_2O$) at 1 kb pressure at 600°–975°C. The phases encountered are described. Two different ternary univariant reactions and three quaternary univariant reactions were established at different temperatures. An equilibrium diagram is constructed for the whole system from these and published results. Applications to carbonatites and the thermal metamorphism of siliceous limestones are discussed briefly.—D.B.V.

1102 **Wynn, L. L.** Gas fields from Hartshorne Sand of Arkoma Basin [abs.]: Am. Assoc. Petroleum Geologists Bull., v. 49, no. 9, p. 1561, 1965.

1170 **Yasso, Warren E.** Oceanography—A study of inner space: New York, Holt, Rinehart and Winston, 176 p., illus., 1965.

The accomplishments and potential of deep-sea oceanography are reviewed, with discussion of the Earth's structure, ocean-basin topography, sediments and turbidity currents, marine biology, ocean-water chemistry, and research vessels in detail.—G.D.C.

1439 **Yerkes, R. F.; McCulloh, T. H.; Schoellhamer, J. E.; Vedder, J. G.** Geology of the Los Angeles basin, California—An introduction: U.S. Geol. Survey Prof. Paper 420–A, p. A1–A57, illus., tables, 1965.

The Los Angeles basin is notable for its great structural relief and complexity in relation to its geologic youth and small size and for its prolific oil production. In this chapter, the stratigraphy, structure, and geologic history of the basin are reviewed and the oil production, occurrence, and reserves are summarized.—W.L.G.

1043 **Youash, Younathan Yousif.** Experimental deformation of layered rocks [abs.]: Dissert. Abs., v. 26, no. 2, p. 988, 1965.

**Young, H. L.** *See* Cotter, R. D. 1402

1429 **Zapp, Alfred D.** Bauxite deposits of the Andersonville district, Georgia: U.S. Geol. Survey Bull. 1199–G, p. G1–G37, illus., tables, geol. map, 1965.

The Andersonville district, Georgia, is one of the two most important bauxite mining districts in the Southeastern States. This investigation included surface geologic

mapping of the district and subsurface exploration by more than 1,100 test holes. In 1943, the district probably contained slightly less than 6 million long tons of bauxite containing at least 51 percent alumina, of which < 10 percent could be mined profitably. The bauxite occurs generally as relatively thin flat-lying tabular bodies within larger lenses of sedimentary kaolin in the Nanafalia Formation of the Wilcox Group of early Eocene age.—W.L.G.

**Zeller, E. J.** *See* Dort, Wakefield, Jr. 1256

1340 **Zeller, Robert A., Jr.** Stratigraphy of the Big Hatchet Mountains area, New Mexico: New Mexico Bur. Mines and Mineral Resources Mem. 16, 128 p., illus., tables, 1965.

A thick, complete sequence of sedimentary formations is found in the area between the Precambrian basement rocks and the Tertiary volcanics. The column is about 20,000 feet thick, half Paleozoic rocks and half lower Cretaceous, the lower 15,000 feet being almost entirely marine in origin and the upper 5,000 feet, mostly terrestrial. The Paleozoics are chiefly limestone, rest on an erosion surface cut on the Precambrian granite and quartzite, and are truncated throughout the area by an erosion surface, upon which rest the Lower Cretaceous rocks. These are divided into red beds at the bottom, limestone in the middle, and sandstones above. During most of Paleozoic and Early Cretaceous times, the region was the site of greater deposition and thus greater subsidence than bordering areas; the rock sequence suggests a geosyncline.—M.C.

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